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AFWAL-TR-87-2042 Volume XII



PRODUCTION OF JET FUELS FROM COAL-DERIVED LIQUIDS

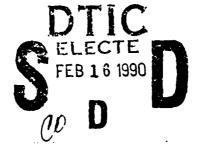
VOL XII--PRELIMINARY PROCESS DESIGN AND COST ESTIMATE AND PRODUCTION RUN RECOMMENDATION

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Fuels Branch

FOR THE COMMANDER

Fuels and Lubrication Division

LEO S. HAROOTYAN, A., Assistant Chief Fuels and Lubrication Division

Aero Propulsion and Power Laboratory

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A preliminary design for the production of JP-8 jet fuel and other salable products from the Great Plains by- products is given. The design incorporates experimental results from Tasks 2 and 3 with the scoping design from Task 1. The experimental results demonstrated the need for more severe hydrotreating conditions to convert the tar oil to jet fuel than was estimated in Task 1. As a result, capital costs for the revised design are significantly higher and the plant is less profitable than estimated in the Task 1 work. The increase in capital costs is offset somewhat by a higher phenol value in the current market. Refined estimates for the cost of an aromatics recovery unit preclude its economical construction in the new estimate, consequently the revised product slate includes no BTX					
Recommendations are given for a 10,000 barrel production run. No commercial domestic facility exists which can provide suitable expanded-bed hydrotreating facilities for a production run of this size. However, an alternative approach using hot filtration and dilute fixed-bed hydrocracking followed by product fractionation and extinctive hydrotreating of the heavy products is recommended. Commercial domestic facilities which might reasonably accommodate this scheme are listed.					
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#### SUMMARY

Amoco and Lummus Crest are contracted with the Department of Energy to develop an upgrading scheme for the liquid by-products (tar oil, phenols, and naphtha) produced by the Great Plains Coal Gasification plant in Beulah, North Dakota. These streams are currently burned in the utility boilers and steam superheaters in the Great Plains plant. Task 1 through 3 of the contract are complete. Task 1 results were reported previously (AFWAL-TR-87-2042, Volume VI), as were the results of Tasks 2 and 3 (AFWAL-TR-87-2042, Volume IX). The results of Tasks 4 and 5 are reported here.

A preliminary design for the production of JP-8 jet fuel and other salable products from the Great Plains by-products is given. The design incorporates experimental results from Tasks 2 and 3 with the scoping design from Task 1. The experimental results demonstrated the need for more severe hydrotreating conditions to convert the tar oil to jet fuel than were estimated in Task 1. As a result, capital costs for the revised design are significantly higher, and the plant is less profitable than estimated in the Task 1 work. The increase in capital costs is offset somewhat by a higher phenol value in the current market. In addition, the product slate has changed. BTX production, only marginally profitable in the Task 1 study, was re-evaluated and found to be prohibitive. As a consequence, the flow scheme is simplified by the removal of the aromatics recovery unit from the Task 1 design.

Recommendations are given for a 10,000-barrel production run. No commercial domestic facility exists which can provide suitable expanded-bed hydrotreating facilities for a production run of this size. However, an alternative approach using hot filtration and dilute fixed-bed hydrocracking followed by product fractionation and extinctive hydrotreating of the heavy products is recommended. Commercial domestic facilities which might reasonably accommodate this scheme are listed.

#### FOREWORD

In September 1986, the Fuels Branch of the Aero Propulsion and Power Laboratory at Wright-Patterson Air Force Base, Ohio, commenced an investigation of the potential for production of jet fuel from the liquid by-product streams produced by the gasification of lignite at the Great Plains Gasification Plant located in Beulah, North Dakota. Funding was provided to the Department of Energy (DOE) Pittsburgh Energy Technology Center (PETC) to administer the experimental portion of this effort. This report details the effort of Amoco Oil Company, who, as a contractor to DOE (DOE Contract Number DE-AC22-87PC90015), conducted a preliminary analysis of upgrading alternatives for the production of turbine fuels from the Great Plains liquid by-product streams. DOE/PETC was funded through Military Interdepartmental Purchase Request (MIPR) FY1455-86-NO657. Mr. William E. Harrison III was the Air Force Program Manager, Mr. Gary Stiegel was the DOE/PETC Program Manager, and Mark Furlong and Eruce Fleming were the Amoco Program Managers.

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# SECTION I INTRODUCTION

The Great Plains Coal Gasification Plant in Beulah, North Dakota, produces about 145 MM SCF/D of substitute natural gas (SNG) from lignite. The plant also produces three liquid by-products: about 2,900 B/D of tar oil, 830 B/D of crude phenols, and 650 B/D of naphtha. These liquids are all products from the devolatilization of lignite in the Lurgi gasifiers. Currently, the by-products are burned in the plant's boilers and superheaters to produce steam. The economic viability of the plant might be improved by producing marketable products, rather than steam, from these by-product liquids. To this end, Amoco and Lummus Crest, under a contract with the United States Department of Energy, are investigating the technical and economic feasibility of converting the by-product liquids to jet fuels and other saleable products. Jet fuels are of particular interest because of the close proximity of Great Plains to several U.S. Air Force bases, and the obvious strategic interest in maintaining a constant, proprietary source of jet fuel for those bases.

#### SECTION II

#### PROJECT OVERVIEW

As shown in Figure 1, this project is divided into five major tasks: Process Concept Definition, Bench Scale Testing, Pilot Plant Testing, Preliminary Process Design and Economics, and Production Run Recommendation. The results of Tasks 4 and 5 are reported here.

The first task, Process Concept Definition, included three subtasks: Liquid By-product Analysis, Process Modelling and Design, and Economic Modelling. The first subtask (1.1), By-product Analysis, involved analytical characterizations of samples of each by-product taken at sixweek intervals. The results from this program, which provided an indication of the average quality of each stream and the variability of that quality over time, were an important input to the second subtask (1.2), Process Modelling and Design. Other inputs to the second subtask included limited experimental processing data on the Great Plains byproducts by the Western Research Institute (WRI), (1) Amoco's petroleum refining process models and linear programming technology, Lummus' process simulation and design programs and a market analysis of by-products from Great Plains developed by Sinor Consultants. (2) In addition, throughout Task 1, ANG Coal Gasification Company provided valuable input and advice on all fronts. The major objective of Subtask 1.2 was to produce seven conceptual designs and associated capital and operating costs for facilities to refine the Great Plains by-products. These included designs for maximizing production of each grade of jet fuel (JP-4, JP-8, JP-8X), designs for profitable schemes which produce the various jet fuel grades, and a scheme for maximizing profits. In Subtask 1.3 the results generated by Amoco and Lummus were subjected to economic analysis.

The two products from Tasks 1 were the design and economic results for each of the seven designs and a plan for bench scale testing (Task 2) to confirm any assumptions made in Task 1. The final report for Task 1 was issued by the U.S. Air Force in September 1988. (3) Based on the design and economic results from Task 1 and preliminary results from Task 2, the Department of Energy and the Department of Defense decided on a preferred processing scheme for the Great Plains liquids, the "Profitable JP-8" case developed in Task 1. Amoco carried out pilot plant testing (Task 3) of the process design from Tasks 1 and 2 and provided barrel quantities of product for testing by the United States Air Force and associated contractors. The final report for Tasks 2 and 3 was issued by the U.S. Air Force in June 1989. (4)

The pilot plant results were used by Amoco and Lummus to develop a preliminary process design and economics (Task 4) for a plant to upgrade the liquid by-products at Great Plains. Finally, in Task 5, Lummus suggested existing facilities where the processing scheme might be carried out on a scale sufficient to provide jet fuel for aircraft testing. The results of Tasks 4 and 5 are reported here.

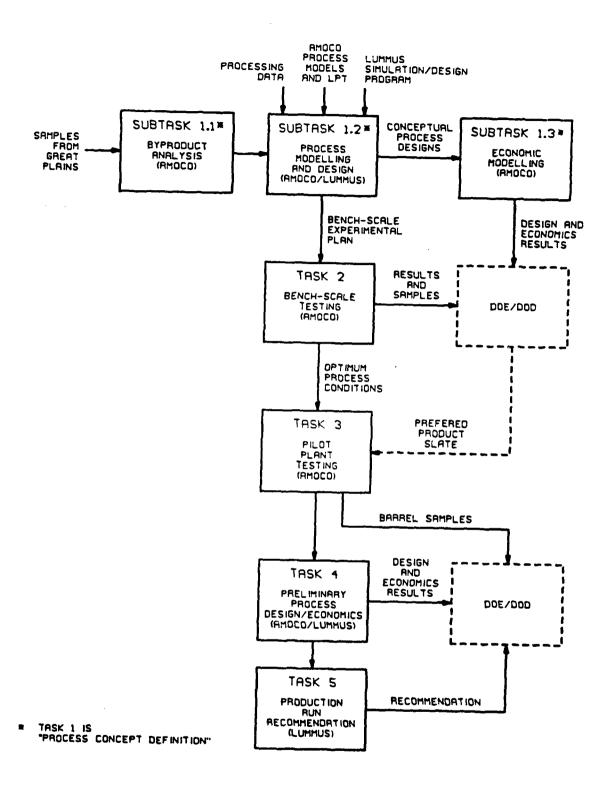


FIGURE 1
PRODUCTION OF JET FUEL
FROM COAL DERIVED LIQUIDS:
AMOCO/LUMMUS ACTIVITIES

#### SECTION III

#### SOURCE OF BY-PRODUCT LIQUIDS

Tar oils, crude phenols, and naphtha are produced at the Great Plains Gasification Plant; a schematic of the plant is shown in Figure 2. The plant currently produces about 145 MMSCFD of synthetic natural gas (SNG) from North Dakota lignite. The SNG is composed almost entirely of methane, which is derived mostly from synthesis gas ( $\rm H_2$  + CO) produced in the Lurgi Mark IV gasifiers and methanated in downstream reactors. The liquid by-products (tar oil, phenolics, and naphtha) are produced during lignite devolatilization in the gasifiers.

The tar oil and phenolics are condensed from the product gas along with water vapor to form a gas liquor. This condensation takes place in heat exchangers located in the gasifier quench, shift converter, gas cooling, and Rectisol units. The liquor is routed to the gas liquor separation unit, where the tar oil is recovered by gravity separation. The heaviest portion of the tar oil, which contains about 20 percent coal dust, is recycled to the gasifiers. The recycle rate of this "dusty tar" is about 1800 B/D. The remaining tar oil, which contains 2-6 percent dust, is produced at a rate of 2900 B/D. The phenolics are recovered from the gas liquor by extraction with isopropyl ether in the Phenolsolvan unit. The resulting crude phenol stream, which is produced at a rate of about 830 B/D, is composed mostly of phenol, cresol, and xylenol, with the remainder being water and neutral oils. The naphtha is condensed from the gasifier raw gas by contacting the stream with cold methanol in the Rectisol unit. The naphtha is produced at a rate of 650 B/D.

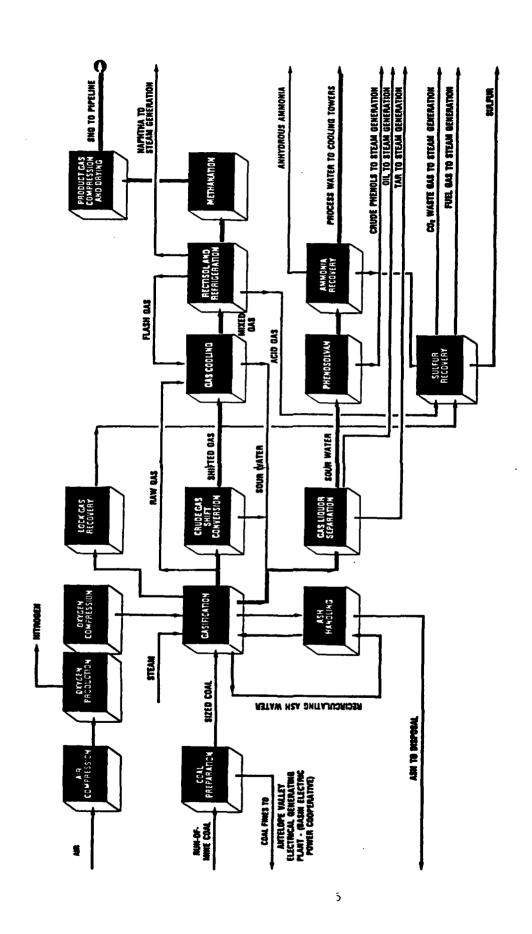


FIGURE 2. GREAT PLAINS GASIFICATION PROCESS BLOCK FLOW DIAGRAM

#### SECTION IV

#### TASK 4 RESULTS

#### 1. Preliminary Process Design

Lummus Crest Inc., under subcontract with Amoco Oil on this project, generated a preliminary process design to convert the tar oil, naphtha, and phenols streams from the Great Plains Coal Gasification Plant to jet fuels, gasoline, and salable chemicals products. As part of Task 1 of this project, seven processing schemes were generated, as indicated in Table 1. Initial design bases were formulated for each case using proprietary linear programming techniques and process models from Amoco and design expertise at Lummus Crest Inc. The Task 1 results were reported earlier. (3) As a part of Task 2 the U.S. Air Force and the Department of Energy selected Case 4, "Profitable Product Slate Including JP-8," as the case for further study in Tasks 3 through 5.

#### a. Overall Process Description

Figure 3 shows the block diagram for the preliminary process design. There are three sections to the design: tar oil processing section, naphtha processing, and phenol processing. Each is described briefly.

Tar Oil Processing--The tar oil stream is treated to make JP-8 jet fuel through an expanded-bed hydrotreater, a desulfurization/ denitrogenation unit (HDS), and a final stage of hydrocracking. Only the fraction of the tar oil boiling above 300°F is treated. The 300°F- fraction is removed by distillation prior to hydrotreating, as the low-boiling fraction is unsuitable for jet fuels.

The first stage hydrotreater consumes 3073 SCF hydrogen per barrel of feed, resulting in a high heat release and necessitating an expanded-bed reactor system to control the reactions. The design basis is a three-stage expanded-bed hydrotreater which removes over 98 percent of the sulfur, nitrogen, and oxygen and converts part of the 525°F+ material to the appropriate boiling range for jet fuel blending. From the hydrotreater, 3224 barrels per day of 200°F+ product is sent to the HDS unit and 162 barrels per day of naphtha is recovered.

The HDS unit desulfurizes and denitrogenates the 200°F+ product from the hydrotreater. Denitrogenation is required to preserve catalyst life in the hydrocracker unit and to produce a 525°F- stream suitable for jet fuel blending. The 525°F+ fraction is sent to the hydrocracker unit, a five-stage unit with 65% conversion per pass. The hydrocracker product is recycled to the HDS unit until the 525°F+ fraction is extinct.

Details of the tar oil processing scheme are given in Appendices A and B, and equipment data and estimate sheets are included in Appendix F.

TABLE 1

# PROCESS MODEL AND DESIGN CASE SUMMARY

THE FOLLOWING DESIGN CASES WILL RESULT FROM ACTIVITIES IN THIS SUBTASK:

CASE	DESCRIPTION			
1	MAXIMUM JP-4 PRODUCTION.			
2	PROFITABLE PRODUCT SLATE INCLUDING JP-4.			
3	MAXIMUM JP-8 PRODUCTION.			
4	PROFITABLE PRODUCT SLATE INCLUDING JP-8.			
5	MAXIMUM JP-8X PRODUCTION.			
6	PROFITABLE PRODUCT SLATE INCLUDING JP-8X.			
7	Maximum profit.			

NOTE: Cases 2, 4, 6, and 7 Require Linear Programming Technology.

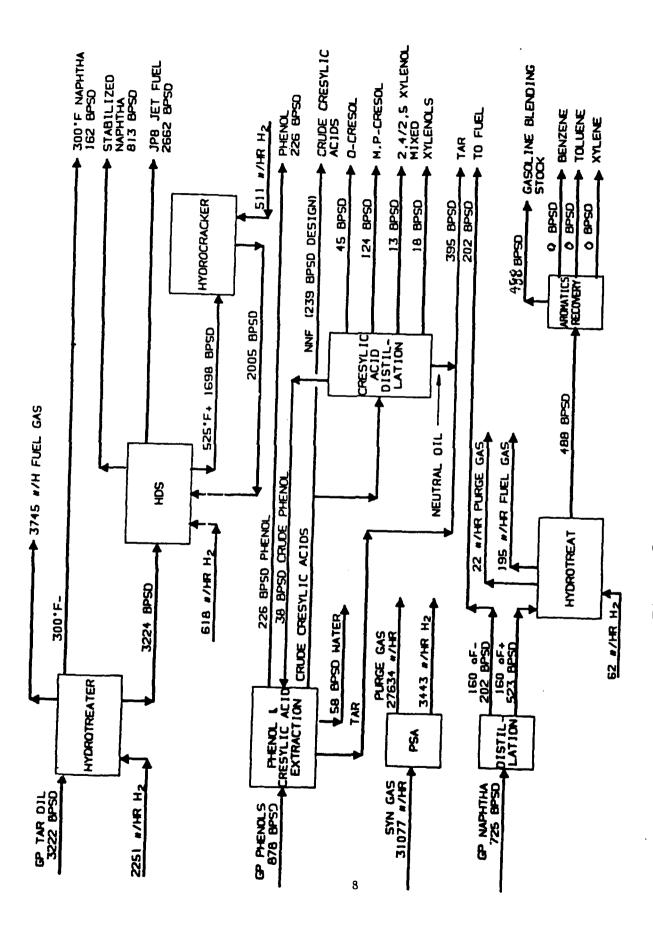


FIGURE 3: PROFITABLE JP-8 DESIGN

Naphtha Processing--Figure 3 shows a naphtha processing scheme that could produce BTX from the 725 barrels per day of raw Great Plains naphtha. The Task 1 study reported this treatment scheme as only marginally profitable. The updated capital and utility estimates have increased in Task 4. The increases are enough to prevent profitable BTX production. As a result, it is recommended that the aromatics recovery unit not be constructed. Figure 3 shows the processing scheme for reference, but with zero flow rates.

A design for BTX production was completed and details are reported in Appendices A and F. The design was necessarily completed before the updated cost data could be fed to the linear program model, which then rejected the naphtha processing as unprofitable.

Phenol Processing--The phenols by-product stream from the Great Plains plant is treated by extraction and distillation to produce phenol, cresols, xylenols, and crude cresylic acids. Approximately 878 barrels of the crude phenol per day are distilled to remove tars and product phenol. Part of the remaining stream, crude cresylic acid, is extracted with hexane and methanol to produce cresols and xylenols.

Details of the phenol processing scheme are given in Appendices A and F, and equipment data and estimate sheets are included in Appendix F.

#### b. Capital Costs

Capital costs for equipment required for the processing schemes shown in Figure 3 are summarized here. Details are given in Appendix C.

Table 2 summarizes the cost for each section of the processing scheme. The total cost is \$121.4 million, an increase of approximately one third over the estimate provided in Task 1. The increase is reflected primarily in the tar oil hydrotreating section, which now includes an additional hydrotreating vessel and preliminary distillation section. Note that the \$121 million includes the cost of constructing naphtha distillation and hydrotreating equipment and an ARU (aromatics recovery unit) to produce BTX from the raw naphtha stream. The linear programming model shows that BTX production is unprofitable, so that the ARU is not included in the final design basis for the profitable JP-8 case. In the maximum profit case, neither the ARU nor the distillation/hydrotreater sections are included. The costs are given here for completeness.

The cost estimates were made at Lummus based on the processing schemes and their return cost data for similar equipment items. The equipment was factored to size and present-day costs based on historical ratios. Engineering costs are included on the basis of the number of equipment items, and a 20% contingency is included in the capital estimates. The estimates do not include spare parts, start-up, insurance, taxes, permits, or royalties on processing technologies.

#### c. Operating Costs

Costs for labor, utilities, catalysts, chemicals, and maintenance supplies are given in Appendix D. Manpower is allocated at 17 people per shift with maintenance integrated with the existing Great Plains maintenance

TABLE 2

CAPITAL COST SUMMARY

•	(Thousands of \$)
Area 100 Hydrotreater Area 200 HDS & JP-8 Area 300 HDC Area 400 OSBL Area 500 Catalyst Handling Area 600 Naph. Dist & HDT Area 700 ARU Area 800 Phenol Ext. Area 850 Cresylic Acid Ext. Area 900 Cresylic Acid Dist	\$ 25,992 34,761 5,803 12,802 1,409 5,403 10,338 11,909 5,361 7,508
Area 700 ARU Solvent Invent.  Total	\$121,287 110 \$121,397

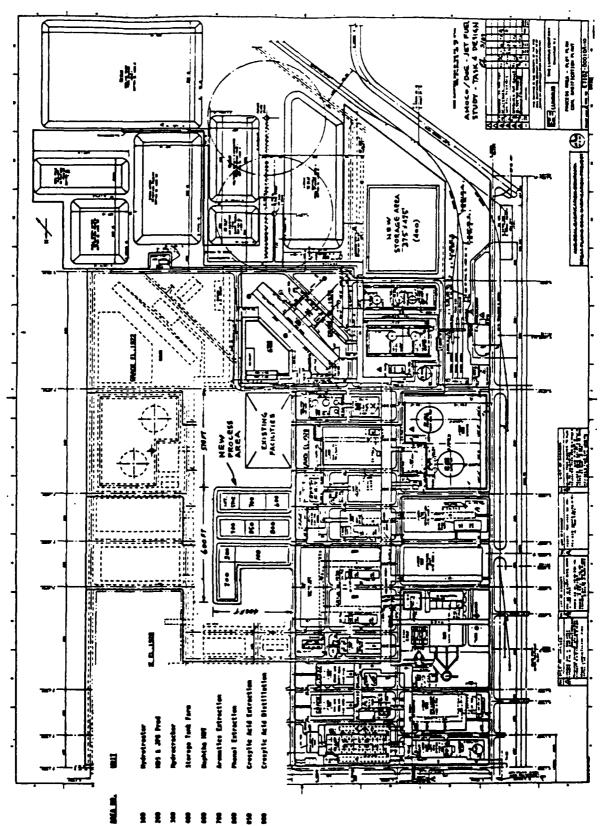


FIGURE 4: PLOT PLAN TIE-IN

crew. A total of 87 additional people would be required. Utilities costs total \$93.5 thousand per day, catalysts and chemicals \$2.8 thousand per day, and maintenance supplies \$6 thousand per day.

#### d. Plot Plan and Tie-ins

Figure 4 shows the integration of the new processing units with the existing Great Plains facilities. The units will be sited in an area 400 by 600 feet east of the existing Rectisol unit. In addition, a storage tank area, approximately 375 by 425 feet, will be required for storage of product and replacement fuel oil. Details of the plot plan are given in Appendix E. Note that the plot plan includes space allocated for the ARU, which was eliminated after formulation of the plot plan.

### 2. Preliminary Cost and Profitability Estimates

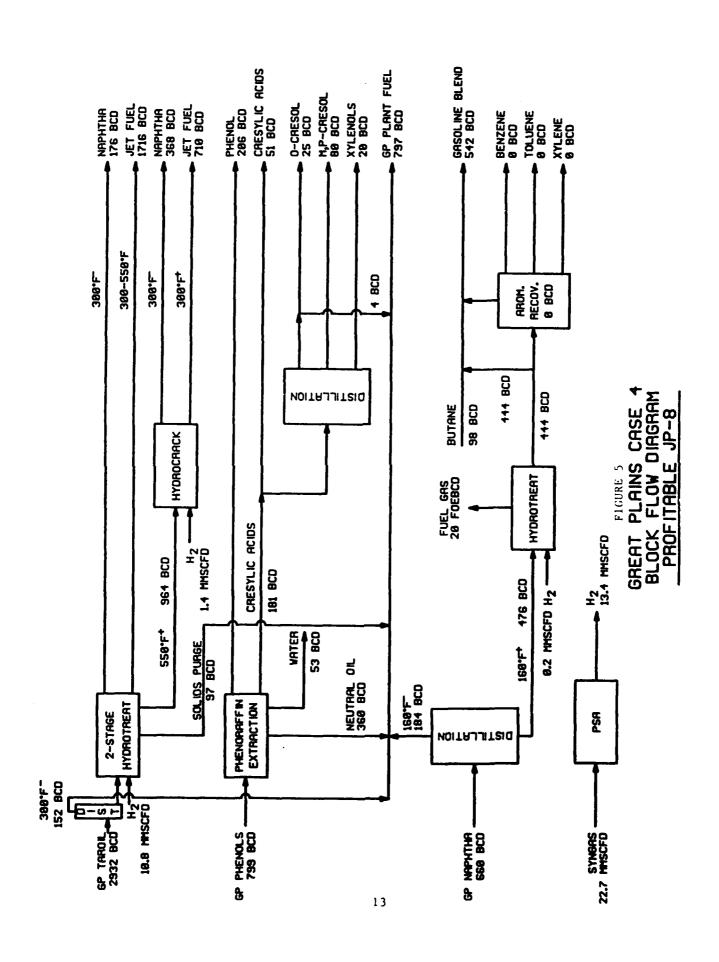
With capital and operating costs provided by Lummus Crest Inc., Amoco Oil Research and Development estimated the cost and profitability of production of JP-8 and other salable products from the Great Plains by-product tar oil, naphtha, and phenol streams. The estimates were made with Amoco's proprietary linear programming models with product values based on in-house expertise, a report by J. E. Sinor, (2) and a letter from Burns and Roe Services Corporation to J. G. Masin of Amoco (Appendix G). In addition to the estimates for the "Profitable JP-8 Case," revised profitability estimates for the "Maximum Profit Case," in which no JP-8 is manufactured, are provided for comparison. Also, since the profitability of the cases is sensitive to a number of factors, especially fuel replacement cost and the marketability of specialty chemicals like xylenols, a brief analysis of the effects of changes in those variables is provided.

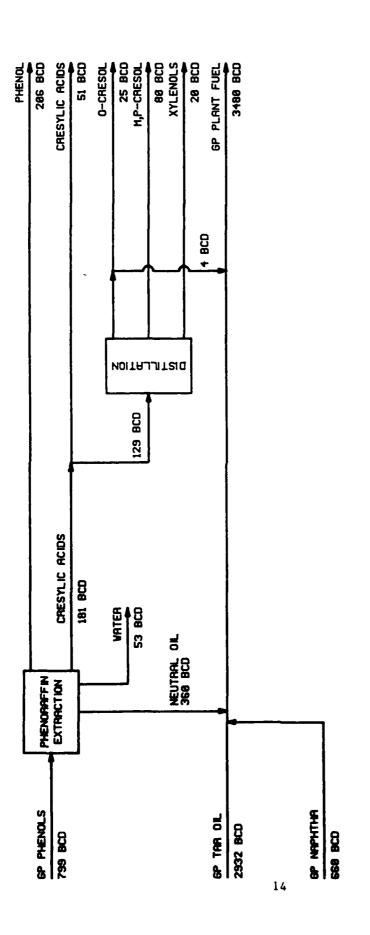
#### a. Linear Programming Flowsheets

Amoco's proprietary linear programming models use in-house process expertise and current product values to optimize the configuration and flow rates to the most profitable processing scheme. Figures 5 and 6 are flowsheets for the "Profitable JP-8" and "Maximum Profit" cases, respectively. Note that most of the flow rates are given in units of barrels per calendar day, rather than barrels per stream-day, as in the design schematic (Figure 3).

There are two fundamental differences between the design case, Figure 3, and the optimized linear programming case for profitable JP-8 production, Figure 5. First, the linear programming model is constrained to limit sales of cresols and xylenols, giving lower outputs of those products. Second, increases in the capital cost of the aromatics recovery unit caused the LP to reject construction of the ARU, recommended in Task 1, as unprofitable. These differences are discussed below.

<u>Chemical Sales</u>--Both in the Task 1 and Task 4 studies, chemical sales were limited to 10 percent of the United States market. This limitation is an artificial constraint, and no attempt to define the effect of market penetration on the product value has been included. The effect of relaxing this constraint is discussed later.





GREAT PLAINS CASE 7 BLOCK FLOW DIAGRAM MAXIMUM PROFIT

TABLE 3 EFFECT OF CHEMICALS SALES LIMITS MAXIMUM PROFIT CASE

Chemical	<u>Sales Limits.</u> <u>Sinor</u>	MBCD SRI
Benzene	Unlim	Unlim
Toluene	Unlim	Unlim
Xylene	Unlim	Unlim
Phenol (1)	Unlim	2.192
o-Cresol	0.25	0.61
m,p-Cresol	0.80	0.38
Xylenols (2)	0.30	0.485
Cresylic Acids	1.40	
Profit, MM\$/yr (3)	9.2	15.1

- (1) Sinor \$80/Bbl, SRI \$157-175/Bbl
- (2) SRI broke down into individual isomers(3) Limit to 10% of cresol and xylenols

The market limits were defined in reports by Sinor<sup>(2)</sup> and SRI (Appendix G). Table 3 summarizes the sales constraints based on information from the cited reports. The Sinor information was used in the Task 1 study; the impact of the SRI values are reported here. Based on the "Maximum Profit" case, the annual profit from sales of chemicals increases from \$9.2 million to \$15.1 million in going to the updated costs. The primary difference, though, is not that the quantity of chemicals sold has changed, but that the value of phenol has doubled from about \$80 per barrel to about \$160 per barrel. The impact of the increased phenol value on the "Profitable JP-8" case is discussed in conjunction with the differences in the capital costs, below.

<u>Differences in Capital Costs</u>--Process data from Tasks 2 and 3 redefined the tar oil processing scheme used in Task 1. More severe hydrotreating is required than assumed in the Task 1 estimates and, as a result, the capital costs for the hydrotreater section increase from \$45.6 million in Task 1 to \$63.2 million in the Task 4 estimate (Table 4). Note that the costs reported in Table 4 include OSBL (outside battery limits) costs and, therefore, are higher than the values reported directly by Lummus (Table 2 and Appendix C), which did not include OSBL. In total, the capital investment for the "Profitable JP-8" case increased from \$85 million in Task 1 to \$110 million in spite of the elimination of the ARU.

Tables 5 and 6 summarize the effects of the increased capital cost and the impact of the higher phenol value on the "Profitable JP-8" and "Maximum Profit" cases, respectively. Overall, the increase in capital costs if the ARU is included in the processing scheme causes the "Profitable JP-8" case (Table 5 and Figure 5) to drop from a profit of \$4.5 million per year to a deficit of \$7.3 million, at the phenol value used in Task 1, \$80 per barrel. However, at the updated phenol price, \$160 per barrel, the deficit is largely offset. At the higher phenol value, the deficit drops to \$1.3 million per year.

BTX production was only marginally profitable in Task I. Revised operating costs now make it unprofitable. Since BTX production is unprofitable, the by-product naphtha stream is hydrotreated and sent to gasoline blending stock in the "Profitable JP-8" case. Without the ARU, the capital investment for the "Profitable JP-8" case drops from \$124 million to \$110 million, and the case nets a profit of \$500,000 per year. The ARU is shown in Figure 5, but the flow rates are listed as zero. The ARU would not be constructed.

The impacts of the phenol value and elimination of the ARU for the "Maximum Profit" case, Figure 6 and Table 6, are similar to those for the "Profitable JP-8" case. At the lower phenol cost and with ARU construction, the profit drops from \$14.9 million in Task 1 to \$6.6 million in the updated estimate. However, the increased phenol value boosts the profit to \$12.7 million. The ARU is unprofitable at the higher revised cost, so the LP reflects this most profitable case. Note that the "Maximum Profit" design provides for no jet fuel production. Consequently, the only hydrogen requirement is for the naphtha hydrotreater, 205,000 SCF per day. The small volume of gasoline blending stock produced by the naphtha hydrotreater, coupled with the costs of building a pressure swing absorption (PSA) unit to produce the hydrogen, makes the naphtha hydrotreater unprofitable. Therefore, the "without ARU" column in Table 6 reflects elimination of the naphtha hydrotreater, as

TABLE 4

GREAT PLAINS INVESTMENT AND UTILITIES SUMMARY

Unit Investment	Max	Profit	Profi	t JP-8
ŞMM_	<u>Task 1</u>	Task 2	Task_l	Task 2
Aromatics Rec	12.3	0	12.3	0
Phenoraffin	19.4	28.1	19.4	28.1
Tar Oil Distil	0	IJ	0	4.8
Hydrocracking	0	0	11.2	6.3
Hydrotreating	0	0	31.3	52.1
Naphtha Distil	0.2	0	0.2	0.2
Naphtha Hydrotrtg	4.5	0	4.5	6.2
PSA	0.5	0	9.0	10.9
Power Distribution	0.1	0.1	1.4	1.5
Total	37.0	28.2	89.3	110.3
<u>Utilities</u>				
Cat and Chem, \$/D	790	450	1,780	3,430
Fuel, FOEB/D	926	599	4,626	2,502
Power, MW	0.2	0.1	6.8	4.1
Cooling Wtr, Mgpm	0.1	2.8	2.7	6.7
Process Wtr, gpm	2	53	43	90
Steam, MLb/Hr	26.9	0	37.7	62.8

TABLE 5

EFFECT OF TASK 2 AND 3 PROCESS DATA
PROFITABLE JP-8 CASE

			Task 4		
	<u>Task l</u>	With	ARU	W/O_ARU	
Profit, \$MM/Yr Capital, \$MM	9.0 89.3	-7.3 123.6	-1.3 123.6	0.5 110.3	
Bases					
Phenol Price, \$/B	80	80	160	160	
Products, BCD					
Gasoline	306	306	306	925	
Reformer Feed BTX	980 321	353 334	353 334	162 0	
JP-8	2,320	2,427	2,427	2,427	
Phenol	283	206	206	206	
o-Cresol	21	25	25	25	
m,p-Cresol	53	80	80	80	
Xylenol	30	20	20	20	
Cresylic Acids	138	51	51	51	

TABLE 6

EFFECT OF TASK 2 AND 3 PROCESS DATA

MAXIMUM PROFIT CASE

		Task 4		
	Task 1	With	ARU	W/O ARU
Profit, \$MM/Yr Capital, \$MM	14.9 37.0	6.6 48.6	12.7 48.6	13.7 28.2
<u>Bases</u>				
Phenol Price, \$/B	80	80	160	160
Products, BCD				
Gasoline	62	62	62	0
Reformer Feed	0	0	0	0
BTX	389	390	390	0
Phenol	283	206	206	206
o-Cresol	21	25	25	25
m,p-Cresol	53	80	80	80
Xylenol	30	20	20	20
Cresylic Acids	138	51	51	51

well as the ARU. In the "Maximum Profit" case the naphtha would be burned as plant fuel.

#### b. <u>Economics Summary</u>

Tables 7 and 8 summarize the profitability, investment costs, feed and product flow rates, and cash flows for the "Profitable JP-8" and "Maximum Profit" cases. The Task 1 estimates are included for comparison.

Changes in the tar oil processing scheme as a result of the Task 2 and 3 work, refinements in the capital estimates, and changes in the product values have impacted the product slates for both cases (Table 7). Relative to the Task 1 estimates, the "Profitable JP-8" case now produces more gasoline and liquid fuel and produces correspondingly less BTX and naphtha (reformer feed). A tar oil distillation unit is required for preseparation of the 300°F- fraction before hydrotreating; this was not included in the Task 1 designs. In both the "Profitable JP-8" and the "Maximum Profit" cases, there is no aromatics recovery unit. In addition, the "Maximum Profit" case now no longer has naphtha distillation, naphtha hydrotreaters, or PSA units. As a result the product slate for the "Maximum Profit" case shifts slightly toward less chemicals production.

Table 8 summarizes the cash flows for the "Profitable JP-8" and the "Maximum Profit" cases, comparing the Task 1 and the Task 4 estimates. The "Profitable JP-8" case yields an annual total profit of just \$0.5 million now versus \$9.0 million in the Task 1 estimate. The primary changes are lower net income from sales, primarily due to the elimination of the ARU, and the increase in capital costs as a result of the more complex tar oil treatment. The primary cause of decreases in the profitability of the "Maximum Profit" case is the decrease in net sales due to the elimination of BTX and gasoline production from the naphtha stream. Increased capital costs for the Phenoraffin unit are balanced by elimination of the naphtha treatment units, so that capital costs remain about even between Tasks 1 and 4. Fuel costs drop significantly, since the naphtha stream remains in the fuel pool. The net effect is that the profit remains about the same as the original estimate.

### c. <u>Economic Sensitivities</u>

The profitability of both the "Profitable JP-8" and the "Maximum Profit" cases varies considerably with the value of the product streams and fuel costs. The former was evidenced above by the impact of revised phenol price structures since the Task 1 report. In this section the effects of the cost of replacement fuels and limitations on cresylic acid and cresol sales are discussed.

Replacement Fuel Costs--Figure 7 shows the impact of replacement fuel costs on the "Maximum Profit" case. Essentially, the effect of fuel cost is unchanged, although the curve is slightly flatter now since the naphtha stream remains in the fuel pool and is not processed. The estimates in Tables 4 through 8 are based on a fuel cost of \$2.15 per million BTU.

TABLE 7

GREAT PLAINS LIQUID BYPRODUCTS CASE SUMMARY

	Max P	rofit	Profit JP-8			
Economics	<u>Task l</u>	Task 4	Task 1	<u>Task 4</u>		
Profit, \$M/CD	40.9	37.4	24.7	1.3		
Profit, \$MM/Yr	14.9	13.7	9.0	0.5		
Investment, \$MM	37.0	28.2	89.3	110.3		
Feedstocks, BCD						
GP Naphtha	660	0	660	660		
GP Phenol	833	799	833	799		
GP Tar Oil	0	0	2,896	2,932		
Syngas, MMSCFD	0.4	0	23.2	22.7		
Products, BCD						
Gasoline	64	0	306	925		
Reformer Feed	0	0	980	162		
Jet Fuel	0	0	2,320	2,427		
BTX	389	0	321	0		
Chemicals	525	331	525	382		
Liquid Fuel	450	364	456	798		
Unit Capacity, BCD						
Aromatics Rec	428	0	355	0		
Phenoraffin	833	799	833	799		
Tar Oil Distil	0	0	0	2,932		
Hydrocracking	0	0	747	964		
Hydrotreating	0	0	4,797	4,441		
Naphtha Distil	660	0	660	660		
Naphtha Hydrtg	476	0	476	476		
PSA, MMSCFD	0.4	0	23.2	22.7		

TABLE 8 GREAT PLAINS ECONOMICS SUMMARY

	Max_1	Profit	Profit JP-8		
Cash Flow, \$M/CD	<u>Task l</u>	Task 4	<u>Task l</u>	Task 4	
Net Sales(1)	79.9	55.4	158.5	143.8	
Fuel <sup>(2)</sup>	-14.6	0.2	-66.9	-65.2	
Cat and Chem	-0.8	-0.5	-5.0	-3.4	
Utilities <sup>(3)</sup>	-0.9	-0.7	-7.3	-8.5	
MTIO <sup>(4)</sup>	-4.1	-3.1	-9.8	-12.1	
Fixed Costs <sup>(5)</sup>	-2.6	-1.4	-5.2	-4.7	
Capital Recov <sup>(6)</sup>	<u>-16.4</u>	<u>-12.5</u>	<u>-39.5</u>	<u>-48.7</u>	
Total Profit	40.8	37.4	24.8	1.3	
Total, \$MM/Yr	14.9	13.7	9.0	0.5	

<sup>(1)</sup> Includes naphtha, gasoline, BTX, and chemicals, less the cost of purchased gasoline blending stocks (e.g., butane).

<sup>(2)</sup> Includes Great Plains naphtha, tar oil, phenol, and hydrogen removed from syngas, as well as purchased fuel, less credit for fuel returned to the Great Plains pool. Hydrogen is priced at a premium over fuel value.

<sup>(3)</sup> Includes power, steam, process water, and cooling water.
(4) Maintenance, taxes, insurance, and overhead charges.
(5) Primarily operating labor.
(6) 16.1%/year of capital. See Table II for basis.

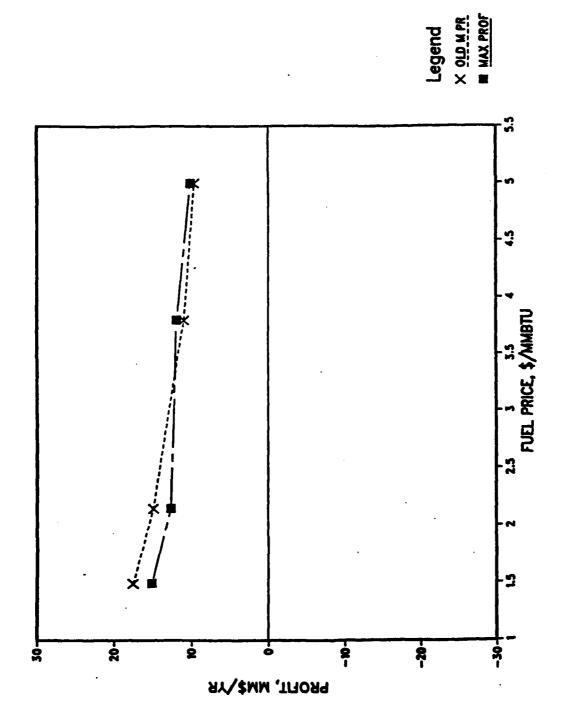


FIGURE 7
MAXIMUM PROFIT CASE
EFFECT OF FUEL PRICE

Effect of Chemical Sales Limitations—Table 9 and Figure 8 show the effect of relaxing the restraints placed on cresol and cresylic acid sales. The profitability estimates reported above are based on cresol and cresylic acid sales limits of 10 percent of the domestic market. The market for these chemicals is small enough so that the Great Plains phenols stream could provide as much as 40 percent of the domestic demand. If the product values held at current levels at all values of percent of U.S. market, the profitability of "Maximum Profit" case would vary according to curves shown in Figure 8. Figure 8 shows the net profit from chemicals sales versus penetration of the domestic cresol and xylenol market. Curves are shown for varying penetrations of the cresylic acids market. Increased market penetration gives increased profits, assuming no change in the product value. Unlimited chemicals sales increase the profitability from \$13.7 million per year for the 10 percent limitations to \$21.3 million per year.

Effect of Chemical Sales Subsidy on JP-8 Cost--Table 10 lists the costs of JP-8 for the "Profitable JP-8" case when the value of the jet fuel is subsidized by chemical sales and when it is not. The value of JP-8 was taken as \$21.84 per barrel for this study. For the subsidized case, the net profitability, \$1,300 per day, was distributed to the 2,427 barrels of JP-8 produced to arrive at a net jet fuel cost of \$21.3 per barrel. The unsubsidized case was calculated by distributing the net increased cost of going from the "Maximum Profit" case, wherein no JP-8 is produced, to the "Profitable JP-8" case. The net increased costs for jet fuel production were \$124,600 per day, the increased capital and operating costs, minus \$35,500, the increased sales from additional chemical and fuel manufactured. This \$89,100 per day increase in cost yields 2,427 barrels per day of JP-8, which would break even at \$36.7 per barrel.

TABLE 9

EFFECT OF CHEMICAL SALES LIMITS

			7 of U.S.	Market					
Crescl, Xylenol	0	0	0	10	10	10	20	20	Unl
Cresylic Acids	0	10	20	0	10	20	0	Unl	Unl
Flow Rate, BCD									
Cresol Sales	0	0	0	105	105	55	180	177	231
Xylenol Sales	0	0	0	30	20	10	60	55	114
Cresylic Acid Sales	0	140	280	0	51	280	0	114	0
Fuel Cresol, Xylenol	0	0	0	6	0	0	0	0	0
Unit Capacity, BCD									
Phenoraffin Extract.	799	799	1,167	882	799	1,409	1,027	1,409	1,409
Cresylic Acid Frct	1,304	181	181	181	181	181	242	232	345
Tar Oil Fret	0	0	1.770	399	0	2.932	1,096	2.932	2,932
Dynaphen	181	41	. 0	62	0	. 0	0	0	. 0
Economic Summary									
Investment, SMM	51.8	49.7	58.2	52.7	48.6	63.4	56.7	54.9	54.6
Profit, SM/CD	17.6	26.3	35.9	31.7	18.2	44.4	43.0	51.3	58.2
Profit, SMM/Yr	6.4	9.6	13.1	11.6	6.6	16.2	15.7	18.7	21.3

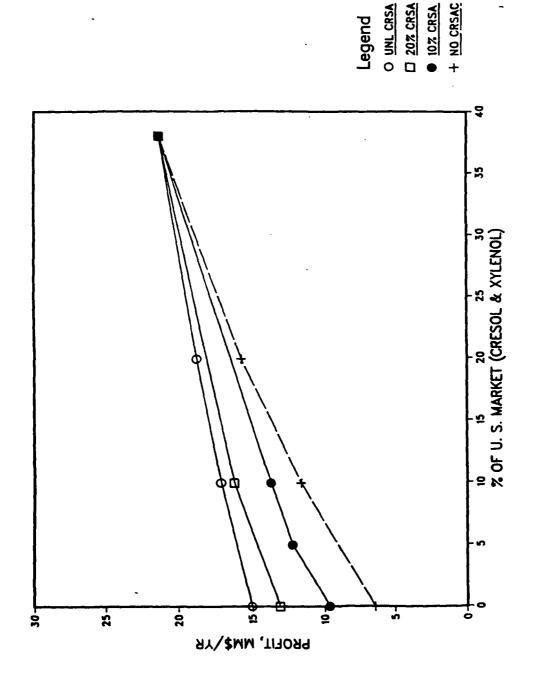


FIGURE 8
MAXIMUM PROFIT CASE
EFFECT OF CHEMICALS SALE

TABLE 10

JET FUEL (JP-8) COSTS
PROFITABLE JP-8 CASE

	<u>\$/Bbl</u>	<u>\$/Gal.</u>
Subsidized by Chemical Sales	21.3	0.51
Unsubsidized	36.7	0.87

### SECTION V

#### TASK 5 RESULTS

Task 5 calls for the recommendation of a 10,000-barrel test run to produce JP-8 from the Great Plains tar oil stream. Lummus Crest Inc. completed this portion of the contract. Their report is included as Appendix H and is summarized here.

#### 1. Production Run Recommendation

Work in Tasks 2 and 3 showed that the first stage of tar oil hydrotreatment requires an expanded bed hydrotreater unit. Two such commercial units exist in the United States, but both are too large to carry out a 10,000-barrel run. Lummus has recommended an alternative approach using a two-stage, fixed-bed hydrocracker system. The tar oil would be treated in five steps:

- 1. Tar oil hot filtration to remove solids to avoid plugging the firststage hydrocracker.
- 2. Hydrocracking at a high recycle rate to handle heat of reaction to lower heteroatom content and to begin aromatics saturation.
- 3. Fractionation of the hydrotreated products.
- 4. Recycle hydrocracking of the 550 F+ fraction to extinction.
- 5. Clay treatment of the blended JP-8 product.

Details of the processing steps are provided in Appendix H.

#### 2. <u>Demonstration Run Facilities</u>

Table 11, excerpted from Appendix H, lists U.S. refineries with hydrocracking capacity which might be able to accomplish a 10,000-barrel run according to the recommended scheme. None of the refineries has been contacted regarding this test, and it is not clear whether any of the facilities would be able to match all the equipment needs of the test. In addition to the refineries listed in Table 11, other options are outlined in Appendix H, including the Wilsonville coal liquefaction facility in Wilsonville, Alabama.

TABLE II

LIST OF REFINERIES WITH HYDROCRACKING CAPACITY

Refinery Name & Address	Contact <u>&amp; Phone</u>	Capacity BPSD	<u>Feed</u>
Tesoro Petroleum Kenai Refinery Box 3691 Kenai, AK 99611	Jose Verdin 907-776-8191	9,000	Residue
Atlantic Richfield Watson Refinery Box 6210 Carson, CA 91749	A. W. Johnson 213-548-8000	22,000	Dist.
Chevron U.S.A. Richmond Refinery Box 1272 Richmond, CA 94802	J. P. Krider 415-620-3000	30,000	Residue
Mobil Oil Torrance Refinery 3700 West 190th St. Torrance, CA 90509-2929	L. K. Williams 213-328-2550	21,700	Dist.
Mobil Oil Beaumont Refinery Box 3311 Beaumont, TX 77704	J. A. Jones 409-883-9411	32,000	Dist.
Texaco Port Arthur Refinery Box 712 Port Arthur, TX 77640	R. E. Anderson 713-982-5711	15,000	Dist.
Texaco Bakersfield Refinery Box 1476 Bakersfield, CA 93302	D. R. Hall 805-326-4200	14,300	Dist.
Texaco Los Angeles Refinery Box 817 Wilmington, CA 90748	R. E. Morris 213-835-8261	20,000	Dist.
Tosco Avon Refinery Martinez, CA 94553	J. M. Cleary 415-228-1220	23,000	Dist.

TABLE II (Continued)

Refinery Name & Address	Contact <u>&amp; Phone</u>	Capacity BPSD	<u>Feed</u>
Unocal 1660 West Anaheim St. Box 758 Wilmington, CA 90744	A. V. Mandlekar 213-513-7600	22,000	Residue
Texaco Delaware City Refinery Delaware City, DE 19706	R. C. Mifflin 302-834-6000	19,000	
Hawaiian Independent 733 Bishop St. Suite 3000, Box 3379 Honolulu, HI 96813	Everett Lewis 808-547-3222	16,000	Residue
Clark Oil, Blue Island Division of APEX Oil 8182 Maryland Ave. St. Louis, MO 63105	S. A. Goldstein 314-889-9600	9,500	Dist.
Marathon Robinson Refinery Robinson, IL 62454	K. N. Warren 618-544-2121	23,000	Dist.
Kerr-McGee Wynnewood Refinery Box 305 Wynnewood, OK 73098	John L. Ray 405-665-4311	5,000	Dist.
Total Arkansas City Refinery 1400 South M St. Arkansas City, KS 76005	Jack Hazen 316-442-5100	3,200	Dist.
Exxon Baton Rouge Refinery Box 551 Baton Rouge, LA 70821-0551	D. H. Daigle 504-359-7711	24,000	Dist.
Exxon Billings Refinery Box 1163 Billings, MT 59103-1163	J. A. MacFarlane 406-657-5380	4,900	Dist.
Exxon Benica Refinery 3400 East 2nd St. Benica, CA 94510-1097	D. L. Wiggins 707-745-7011	29,500	Dist.

TABLE II
(Concluded)

Refinery Name & Address	Contact <u>&amp; Phone</u>	Capacity BPSD	<u>Feed</u>
Sohio 1150 South Metcalf St. Lima, OH 45804	P. Oves 419-226-2300	23,000	Dist.
Sohio Toledo Refinery Box 695 Toledo, OH 43954	J. T. Jacobson 419-698-6408	35,000	Dist.
Sohio Marcus Hook Refinery Box 428 Marcus Hook, PA 19061	J. M. Gibson 215-499-7000	21,000	

#### SECTION VI

#### CONCLUSIONS

Experimental studies in Tasks 2 and 3 showed the need for more severe hydrotreating and hydrocracking to produce jet fuel from the Great Plains tar oil than was anticipated in formulating cost estimates in Task 1. Consequently, the profitability of producing jet fuel and other byproducts dropped from \$9.0 million per year to \$0.5 million per year.

BTX production is no longer profitable in either the "Profitable JP-8" or "Maximum Profit" cases, due to increases in the cost of a small-capacity aromatics recovery unit.

Profitability of chemicals production is improved by new estimates of the value of phenol, which increased from \$80 per barrel in Task 1 to \$160 per barrel today. The increase in phenol value offsets the increased capital costs for the "Maximum Profit" case nearly completely.

A demonstration run to produce 10,000 barrels of JP-8 jet fuel would require modifications to the processing scheme recommended in Task 3. No existing commercial expanded-bed hydrotreater would be suitable for the work. However, the work could probably be carried out in a fixed-bed hydrocracker unit at high recycle rates. Production facilities have been recommended.

### SECTION VII

## RECOMMENDATIONS

Before a production run can be carried out, contact with a number of refining facilities will be required to assure that their facilities can accomplish the work.

The profitability of the chemicals or jet fuel production schemes discussed in this report is highly dependent on fuel and product values and changes in construction costs. Profitability will vary dramatically, as evidenced by the changes in the estimates over the year elapsed between Task 1 and Task 4. Caution should be exercised in utilizing the estimates presented herein.

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- 3. Fleming, B. A., et al., "Production of Jet Fuels From Coal-Derived Liquids, Vol VI, Preliminary Analysis of Upgrading Alternatives for the Great Plains Liquid By-Product Streams," AFWAL-TR-87-2042, September 1988.
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- 6. Gary, J. H., and G. E. Handwerk, "Petroleum Refining Technology and Economics," Marcel Dekker, Inc., 1984, page 140.

## APPENDIX A

LCI Report on "Profitable JP-8" Design:
Case Description

## 1.0 CASE DESCRIPTION

### 1.1 Overall Process Description

The purpose of this design basis is to produce JP-8 type aviation turbine fuel and chemical byproducts to maximize profit from Great Plains liquid by products. Figure 1 presents a block diagram for the process and referring to Figure 1 the flow is as follows:

- . The total Tar Oil byproduct stream (47,670 #/hr, 3222 BPSD) is first fractionated in the Preflash Tower into a 300 F- stream which is sent back to the main boiler in the SNG plant, and a 300 F+ stream which is charged to the expanded bed hydrotreater.
- The hydrotreater is a 3 stage expanded bed type process which removes over 98% of the sulfur, pitrogen, and oxygen compounds and begins the conversion of 525°F+ material. The hydrotreater adds a large quantity of hydrogen to the feed (3073 SCF/bbl) which results in a high heat of reaction. An expanded bed type reactor was chosen to both control and utilize the heat of reaction. Three stages were used to both control the temperature rise as well as to obtain the high efficiency associated with staging a back-mixed reactor.
- The hydrotreater produces 6 streams:
  - A low pressure fuel gas stream (25 psig) which is a mixture of recycle PSA off gas, atmospheric tower overhead gas, as well as overhead gas from Area 200 fractionation.
  - Very low pressure fuel gas (2 psig) which is sent to the low pressure burner.
  - Unstabilized naphtha which is sent to the combined naphtha stabilizer in the HDS unit (Area 200). After stabilization, to control vapor pressure, the naphtha is sent to storage and gasoline blending.
  - A 200<sup>o</sup>F+ stream (atmospheric bottoms) containing most of the hydrotreater liquid product, which is sent to the HDS unit (Area 200).
  - A solids laden vacuum bottoms product which is sent to the battery limits.
  - Wastewater containing NH40H and NH4HS which is sent to the PHOSAM unit in the SNG plant for recovery of the H2S and NH3.

- Approximately 950 #/day of spent catalyst which is shipped to a catalyst reclaimer in the same drums that the catalyst is received in.
- The 200<sup>0</sup>F+ stream from the expanded bed hydrotreater (Area 100) is charged to the HDS unit (Area 200).
- The HDS and JP-8 Fractionation Unit (Area 200) follows the expanded bed hydrotreater. Here the sulfur and especially nitrogen removal is continued to levels compatible with the catalyst in the hydrocracker. In the fractionation section the liquid products (JP-8 and light naphtha) from this plant are stabilized, as well as the hydrotreater naphtha.
- The unit produces 7 steams:
  - A high pressure purge gas which is sent to the recycle compressor in Area 100.
  - Off gas from both the JP-8 tower and the naphtha stabilizer which are sent to Area 100 to be compressed for fuel gas.
  - Off gas from the LP Separator, sent to either fuel gas, or PSA off gas.
  - A stabilized light naphtha stream sent to storage.
  - Stabilized JP-8 sent to storage.
  - A nonconverted 525<sup>o</sup>F+ stream (fractionator bottoms) which is sent to the fixed bed hydrocracker (Area 300).
  - A sour water stream sent to Area 100.
- The Hydrocracker Unit (Area 300) converts the 525<sup>0</sup>F+ material to naphtha and JP-8 turbine fuel. For this service a 5 stage unit was chosen with 65% conversion per pass.
- The hydrocracker produces 3 streams:
  - High pressure purge gas (approximately 90% hydrogen) which is sent to the recycle compressor in Area 100.
  - A combined liquid stream which is sent to the fractionation tower in Area 200.
  - A small sour water stream which is sent to Area 100.

- Hydrogen make-up for all three units; Hydrotreater, HDS and Hydrocracker as well as the Naphtha Hydrotreater (Area 600) is supplied from a PSA Hydrogen Unit. High pressure (355 psig) synthesis gas from the Rectisol Unit (which contains about 63% hydrogen) is charged to the PSA unit which recovers 86% of the contained hydrogen as a high pressure 99.99% purity hydrogen gas product. The remaining purge gas is available at low pressure (5 psig) and has a fuel value of about 565 BTU/ft<sup>3</sup>. This H<sub>2</sub>, CO & CH<sub>4</sub> rich gas is recompressed into the methanation unit of the SNG plant.
- The crude naphtha byproduct stream (8738#/hr, 725 BPSD) is charged to the distillation and hydrotreating unit (Area 600).
- The distillation removes the material boiling below 160°F, which is sent to the SNG plant fuel pool, and produces a bottoms product which is charged to the hydrotreater.
- . The fixed bed hydrotreater is a single bed reactor which removes 99% + of the sulfur, nitrogen and oxygen compounds. Hydrogen is added to the feed at the rate of 430 SCF/bbl.
  - The naphtha hydrotreater produces 4 streams:
    - High pressure purge gas (approximately 90% hydrogen) which is sent to the Rectisol Unit in the SNG plant for recovery of the  $\rm H_2$  and  $\rm CH_A$ .
    - Naphtha which is stabilized to control vapor pressure, and then sent to the aromatics recovery unit (Area 700).
    - A low pressure off gas which is sent to the Stretford unit in the SNG plant.
    - Wastewater containing, NH4OH and NH4HS which is sent to the PHOSAM unit in the SNG plant for recovery of the H2S and NH3.
  - The hydrotreated naphtha is charged to the extraction section of the Aromatics Recovery Unit (Area 700) where it is contacted with a solvent to extract the aromatic components from the stream. The raffinate is sent to storage and gasoline blending while the solvent is recovered from the aromatic extract. The aromatic extract is then sent to fractionation to produce the BTX products.
- Five streams are produced in the Aromatics Recovery Unit.
  - A hydrocarbon gasoline blending stock which is sent to storage and gasoline blending.

- A small process water stream which is sent to the waste treatment plant in the SNG plant.
- Three product streams Benzene, Toluene and Xylene which are sent to storage.
- The crude phenol byproduct stream (13,550 #/hr, 878 BPSD), is fed to the crude phenol processing units.

- Area 800 : Phenol Extraction

Area 850 : Cresylic Acid Extraction
 Area 900 : Cresylic Acid Distillation

- In the Phenol Extraction Area (800) the crude phenol is first distilled to remove the tar (approximately 35% of the feed) and secondly fractionated to remove the phenol and cresylic acid from the light ends cut. The light ends cut is fractionated to recover the entrained phenol.
- The phenol and cresylic acid stream is flashed in a thin film evaporator over a concentrated sulfuric acid mixture to remove pyridine type substances. The vapor phase is dried and then distilled to extract phenol from the cresylic acid mixture.
- The phenol product is purified with steam and sent to storage. The resulting cresylic acid mixture is sent to Section 850.
- . The tars produced are water washed and sent to fuel.
- Streams produced in the Phenol Extraction Area are:
  - Phenol product sent to storage
  - Cresylic acid mixture sent to Section 850
  - Tar product sent to storage and fuel for the SNG plant boilers.
- The remaining cresol/xylenol mixture is sent to the Cresylic Acid Extraction Area (850) where it is double solvent (hexane and methanol) extracted to remove neutral hydrocarbons. The resulting crude cresylic acid is dried and sent either to storage or distillation (Area 900).
- . The solvents are re-extracted by distillation and recycled to the extractor column.

- Streams produced in the Cresylic Acid Extraction Area are:
  - Neutral Oil mixed with Tars from 800 Area
  - Crude Cresylic Acid sent to distillation (Area 900) or intermediate storage
- The Crude Cresylic Acid is sent to Cresylic Acid Distillation (Area 900) where it is progressively distilled in a 2 block operation scheme.
- Block operation 1 extracts M/P Cresol product, Crude Phenol, o-Cresol and Mixed Xylenol streams:
- Block operation 2 extracts o-Cresol, 2.4/2,5 Xylenols and Mixed Xylenol products and slop cut stream.
- . Streams produced in the Cresylic Acid Distillation Area are:
  - O-Cresol product sent to storage
  - M/P Cresol product sent to storage
  - 2,4/2,5 Xylenols and Mixed Xylenols products sent to storage
  - Slop cut mixed with the Tar product from Area 800.
  - A Crude Phenol stream which is recycled to Area 800.

## 1.2 Overall Material Balance

The overall material balance which is presented below presents the overall material balance for the major process units computed on the basis that the fuel value of the feed will be replaced by fuel gas, tar oil and 160°F- distillate produced in the process and the difference made up by the purchase of #6 Fuel Oil. Detailed Material Balances for each process area are presented in Section 2 with the Process Flow Diagrams.

The overall balance is as follows:

#### Feeds

3222	BPSD of Tar Oil
878	BPSD of Crude Phenol
725	BPSD of Crude Naphtha
4290	BPSD of #6 Fuel Oil
11.07	MMSCFD equivalent SNG product loss due to the syngas feed to
	the PSA unit

<u>Products</u>	
2662	BPSD of JP-8 turbine fuel
162	BPSD of 300°F - Naphtha for gasoline blending
813	BPSD of stabilized naphtha
226	BPSD of Phenol
45	BPSD of o-Cresol
124	BPSD of m,p-Cresol
13	BPSD 2,4/2,5 Xylenols
18	BPSD of Mixed Xylenols
395	BPSD of Tar_Oil for Fuel
202	BPSD of 160°F- Distillate for Fuel
46	BPSD of Gasoline Blending Stock
315	BPSD of Benzene
112	BPSD of Toluene
15	BPSD of Xylene
6.94	MMSCFD equivalent SNG product credit due to HDT, & PSA purge
	gas reinjection into SNG plant.

## Net Changes in Boiler Fuel Fired

Fuel	#hr	BTU/#	MMBTU/hr	MMSCFD	BTU/ft <sup>3</sup>	BPSD
Tar Oil	-47670	17000	-810.4			- 3222
Crude Phenol	-13550	13070	-177.1			-878
Crude Naphtha	-8738	18500	-161.7			-725
Fuel Gas	3940	18000	70.9	2.19	777	
160 <sup>0</sup> F-	2164	17400	37.7			202
distillate	6117	15000	<b>41 4</b>			205
Tar Oil	6117	15000	91.8			395
Import Steam	89000	710	-63.2			
Fuel Oil to Boiler	56222	18000	1012.			4061
Total			0.0	<del></del>		
Fuel Oil to Process Heat	3172 ers	18000	57.1			229

Net Changes in SNG Production	EQV SNG MMSCFD	PSA/Purge Gas #Mol/SD
SNG equivalent of Syn Gas to PSA	11.07	75443
SNG Credit for PSA Purge Gas	6.92	34388
SNG Credit for Hdtrs Purge Gas	0.02	163
Total SNG Production Loss	4.13	

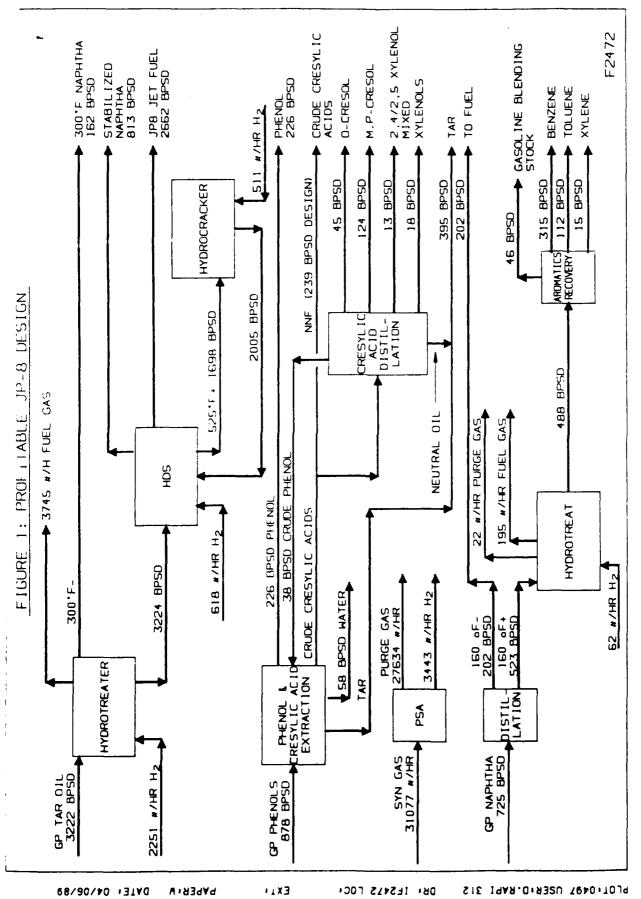
## 1.3 Overall Utility Balance

The overall utility consumption of the complex is as follows:

#6 Fuel Oil SNG Equipment	4290 BPSD
of Syn Gas & Purge Gas	4.13 MMSCFD
	7950 kW
Power	
Cooling Water	8860 GPM (30 <sup>0</sup> F rise)
Process Water	100 GPM

In addition the process utilizes steam as summarized below which was debited against boiler requirements.

HP Steam Import	70,000 #/H
MP Steam Import LP Steam Export	34,500 #/H 15,090 #/H
Condensate Return	101,500 #/H
Boiler Feedwater Import	13,000 #/H



A-10

## APPENDIX B

LCI Report on "Profitable JP-8" Design:
Process Description

## 2.0 PROCESS DESCRIPTION

## 2.1.1 Hydrotreater (Area 100)

### 2.1.1.1 Reaction Section

Operating conditions for the hydrotreater were provided to Lummus by Amoco and these conditions are presented in Table 2.1.1. This information was supplemented by LCI's calculated product properties and detailed yield and elemental balances (2). The basic processing step selected was the expanded bed hydrotreater (LC Fining) system. Due to the extremely high exothermic heat of reaction it was necessary to use 3 reactors with interstage cooling. Referring to Process Flow Diagram E5571-101 the flow is as follows:

- Feed Tar Oil from battery limits is delivered into the Day Tank FA-101, from where it is charged to the Preflash Tower DA-101 through Pump GA-114 and Preflash Heater BA-101.
- In DA-101 the Feed Tar Oil is stripped of 300<sup>0</sup>F-components which are sent back to the SNG plant to be used as fuel.
- The 300°F+ part, which represents the bulk of the Tar Oil is charged into the hydrotreater through Feed Pump GA-101. The charge oil is combined with feed hydrogen gas prior to entering Feed Heater BA-102. The preheated mixture is then charged to the First Reactor DC-101.
- The Expanded Bed Reactor DC-101 approaches isothermal conditions in which the heat of reaction is used to heat the feed up to 760°F.
- The effluent from DC-101 is cooled with both the quench gas from the Recycle Gas Compressor GB-101 as well as the quench naphtha from GA-102. The combined mixture is charged into the Second Reactor DC-102.
- The effluent from DC-102 is cooled in the same manner as the previous effluent and is then charged to the Third Reactor DC-103.
- The effluent from DC-103 flows to the High Pressure/High Temperature Separator FA-102. Both the vapor and the liquid from FA-102 are let down (to 385 psig) to the Low Pressure/High Temperature Separator FA-103. This design uses the LCI patented and commercially proven low pressure hydrogen recovery scheme.

Hot liquid from FA-103 flows to the Vacuum Tower DA-103 for solids removal. The vapors from FA-103 flow through exchangers EA-103 and EA-104 (H.P. steam generator and BWF preheater) and then are flashed in the Low Pressure/Intermediate Temperature Separator FA-104.

The vapors from FA-104 flow through Air Cooler EC-101 where they are cooled to 120 F. Process water is injected upstream of EC-101 to convert the H<sub>2</sub>S and NH<sub>3</sub> in the gas to an aqueous NH<sub>4</sub>OH/NH<sub>4</sub>HS solution. From EC-101 the vapor and liquid stream enter the Low Pressure/Low Temperature Separator FA-105. The hydrocarbon liquid from FA-105 is joined by the liquid from FA-104 and the combined stream if fed to the Atmospheric Tower Feed Surge Drum FA-109.

The gas stream is sent to Recycle Gas PSA Unit PA-104. The resulting 99.99% pure hydrogen stream is combined with a portion of the gas that bypassed the PSA unit and together with high pressure purge gas form Areas 200 and 300 enters the Recycle Gas Compressor GB-101, where it is recompressed to reaction level pressure.

At the compressor discharge the recycle gas stream is joined by the hydrogen make-up stream from Area 200.

The PSA unit off gas (at about 5 psig) is combined with other low pressure gases from Area 200, and after compression to fuel gas header pressure in the Fuel Gas Compressor GB-102 and subsequent cooling in Fuel Gas Cooler EA-107, is sent to the boiler plant as fuel gas.

The water phase from FA-105 joins other sour water streams from Areas 100, 200 and 300 and is sent to the PHOSAM unit in the SNG plant to recovery  $\rm H_2S$  and  $\rm NH_3$ .

### Table 2.1.1 Hydrotreater Conditions

Reactor Type Expanded Bed Number of Reactors 0.2<sub>0</sub>(1/3 per Reactor) 760°F Catalyst Addition Rate Lbs/Bbl Reactor Temperature Reactor Pressure (Outlet 3rd Reactor) 2225 psia Heat Release, Btu/Bbl 80,150 per Reactor Hydrogen Chemical Consumption SCF/BBL 3073 Ratio of H<sub>2</sub> in feed to Chemical H<sub>2</sub> 2.0 min.

Catalyst Type

Shell 324 M (NiMo)

### 2.1.1.2 Fractionation Section

Referring to Process Flow Diagram E5571-102 the flow is as follows. The hot liquid from FA-103 is fed to a refluxed Vacuum Flash Tower DA-103. Here a concentrated (with approximately 30% solids) bottoms stream is withdrawn and sent to battery limits for disposal.

- The top vapor is partially condensed with BFW in the HVGO Condenser/BFW Exchanger EA-101, generating both reflux and a heavy gas oil product stream.
- From the HVGO Accumulator FA-106 the LVGO vapor is condensed in the LVGO Condenser EA-102 and is pumped together with the HVGO stream to the Atmospheric Tower Feed Surge Drum FA-109.
- The vapor off the LVGO Accumulator FA-107 (mainly non-condensable gas) is directed to the Vacuum System PA-101.
- From the Vacuum Hotwell FA-108, a low pressure fuel gas is sent to a special burner in BA-101. The vacuum system uses medium pressure steam. The steam condensate is pumped out by the Sour Water Pump GA-106. This stream with all other sour water streams originating in Areas 200 and 300, is directed to the PHOSAM unit.

The hydrocarbon liquid streams from FA-104 and FA-105 as well as the two vacuum gas oil streams are all combined in the Atmospheric Tower Feed Surge Drum FA-109. Both the vapor and liquid are fed to the Atmospheric Tower DA-102: This tower is reboiled by high pressure steam in the Atmospheric Tower Reboiler EA-105. The tower is provided with a water cooled, Atmospheric Tower Overhead Condenser EA-106 which generates both reflux and a light naphtha product. Both the overhead naphtha and the hot bottoms are sent to the HDS unit (Area 200) where the former is stabilized, while the latter represents the unit feed.

### 2.1.2 HDS and JP-8 (Area 200)

## 2.1.2.1 Reaction Section

The operating conditions for the Hydrotreater, were given by Amoco (1) and presented in Table 2.1.2. This information was supplemented by LCI's calculated product properties (2). Certain parameters such as unit pressure and hydrogen recycle rate had to be increased by LCI in order to achieve a satisfactory hydrogen partial pressure. As shown on the Process Flow Diagram E5571-201 the flow is as follows:

- Hot atmospheric tower bottoms from Area 100 flow to the HDS Feed Surge Drum FA-201, from where the HDS Feed Pump GA-201 pumps the feed to the HDS reactor loop.
- Make up hydrogen from the rectisol unit (see composition in Table 2.1.3) for all three hydroprocessing units is being purified in a PSA unit (PA-201) located in Area 200.
- At the conditions given a 10 bed PSA unit will recover 86% wt. of the hydrogen in the feed according to the manufacturer, Union Carbide EP&P Division.
- The system uses 10 absorption vessels which are sequenced through adsorption, depressurization, purging, and repressurization steps. The process continuously produces product and purge gas (see composition in Table 2.3). It is purchased as a skid mounted unit and the control of the unit is fully automated. Drawing 5571-203 presents a schematic of a Union Carbide Polybed PSA unit.
- The unit, PA-201, selectively absorbs all components except H<sub>2</sub> and produces a 99.99% vol. purity stream at about 345 psig and 80°F.

- This hydrogen stream is compressed in the Make-up Hydrogen Compressor GB-202 to a pressure high enough to satisfy all four hydroprocessing unit pressure levels.
- A controlled amount of make-up hydrogen joins the HDS recycle gas stream and together with the hydrocarbon feed enter the reaction loop.
- This reactor feed mixture is first preheated against reactor effluent in the HDS reactor Feed Effluent Exchanger EA-201, then heated in the HDS Feed Heater BA-201 after which it enters the HDS Reactor DC-201. Cold recycle gas is introduced as quench gas between the two reactor beds.
  - The reactor effluent after being cooled in EA-201 passes through the HDS Reactor Effluent Condenser EC-201 where all the liquid reaction products are condensed. Prior to entering EC-201 wash water is injected into the hydrocarbon stream to convert H<sub>2</sub>S and NH<sub>3</sub> present to an aqueous NH<sub>4</sub>OH/NH<sub>4</sub>H solution. From EC-201, the vapor and liquid enter the HDS Reactor Effluent HP/LT Separator FA-202. The hydrocarbon liquid is pressured to the fractionation section. Sour water is pressured to Area 100.
  - The vapor is compressed in the HDS Recycle Gas Compressor GB-201 and joins the reactor hydrogen make-up, as treat gas. Part of the recycle serves as reactor interbed quench gas.

## Table 2.1.2 HDS Reactor Operation

Reactor Type Number of Reactors Number of Beds/Reactor Catalyst per Bed	Fixed Bed 1 2 Bed 1 1/3
WHSV - HR -1	Bed 2 2/3 1.0
Hydrogen Chemical	
Consumption SCF/Bb1	608
Reactor Pressure (outlet)	2400 psia
H <sub>2</sub> Partial Pressure @ Outlet	1709 psia
H <sub>2</sub> Recycle Rate SCF/Bbl	1836 (excluding quench)
Heat Release BTU/Bbl	41660
Catalyst Tyne	Shell 354 (NiW)

Table 2.1.3 PSA Unit Feed and Purge Gas Properties

Feed Gas (from Rectisol Unit)

Pressure Temp. Composition	355 psig 65 <sup>0</sup> F		Mol%
H2 C0 C02 CH4 C2H6 COS, H2S, CS2 N2 + Ar H2O		< <	63.19 18.61 1.48 16.21 0.31 0.01 0.19 0.01
Purge Gas			
Pressure Temperature Composition			5 psig 100°F Mol %
H2 CO CO2 CH4 C2H6 N2+Ar Others			19.32 40.76 3.24 35.51 0.69 0.41 0.06

## 2.1.2.2 Fractionation Section

- HP/LT separator liquids from both the HDS unit (FA-202 in Area 200) and the HDC Unit (FA-302 in Area 300) are pressured to the JP-8 Tower Feed Surge Drum FA-204.
- Flash gas is sent to fuel, while the liquid after preheat against JP-8 tower bottoms in the JP-8 Tower Feed/Effluent Exchanger EA-202 is further heated in the JP-8 Tower Feed Heater BA-202 and sent to the JP-8 Tower DA-201.
- In this tower JP-8 is taken as a sidestream (with an approximate TBP range of 280 525°F), and all the unconverted 525°F+ material leaves the tower as bottoms.
  - The overhead product naphtha is sent to naphtha stabilization. Since this is a steam stripped tower and so is the JP-8 Product Stripper DA-202, the sour water generated in the JP-8 Tower Overhead Reflux Drum FA-205 is sent to Area 100 (to the suction of GA-106) to be pumped back to the SNG plant.
  - The JP-8 is steam stripped in DA-202, and after serving as a heating medium in the Naphtha Stabilizer Reboiler EA-205, is cooled in the JP-8 Product Cooler EC-202 and sent to storage.
- The naphtha from FA-205 is joined by light naphtha from Area 100, preheated in the Naphtha Stabilizer Feed/Bottoms Exchanger EA-204, and fed to the Naphtha Stabilizer DA-203.
- Here most of the C<sub>A</sub> hydrocarbons are stripped out of the naphtha and joining the overhead gas from the JP-8 Tower DA-201, are sent to Area 100 to be compressed to fuel gas pressure.
- The stabilized naphtha bottoms product after being cooled by exchanger with feed in EA-204 is cooled to storage temperature in the Stabilized Naphtha Cooler EA-207.
- The 525<sup>0</sup>F+ material leaves the JP-8 tower bottoms and is pumped by GA-204 and cooled by EA-202 before being sent to the Hydrocracker (Area 300).

## 2.1.3 Hydrocracker (Area 300)

The operating conditions for the Hydrocracker were provided to Lummus by Amoco and these conditions are presented in Table 2.1.4. This information was supplemented by LCI's calculated product properties and detailed elemental balances (2). The basic processing step is a five bed hydrocracking reactor with interbed quench. Referring to Process Flow Diagram E5571-301 the flow is as follows.

- The 525°F+ material (JP-8 tower bottoms from Area 200) is fed to the HCR Feed Surge Drum FA-301, from which it is pumped via HCR Feed Pump GA-301, mixed with recycle gas, preheated in the HCR Reactor Feed/Effluent Exchanger EA-301 and HCR Feed Heater BA-301 before being charged to the Hydrocracker Reactor DC-301.
- The five bed hydrocracker is quenched with recycle gas between stages to control the bed temperature. The hydrocracker has a conversion of 70% per pass.
- The HCR reactor effluent mixed phase is cooled in HCR Feed/Effluent Exchanger EA-301, injected with water to convert the H<sub>2</sub>S and NH<sub>3</sub> present to an aqueous NH<sub>4</sub>OH/NH<sub>4</sub>HS solution, and then enters EC-301 where all liquid reaction products are condensed. The vapor liquid mixture enters the HCR HP/LT Separator FA-301 from which the hydrocarbon liquid is pressured back to the JP-8 tower feed stream in Area 200.
- The sour water phase in the HP/LT Separator is sent to the SNG plant Phosam unit with the Area 100 and 200 sour water streams.
- The vapors from the HP/LT Separator are sent to the HCR Recycle Gas Compressor GB-301 via FA-303 K.O. Drum. A purge stream is extracted from this stream to control the contaminants and sent to Area 100. The GB-301 Recycle Compressor effluent is partially used as quench gas for the HCR Reactor. The remaining gas is mixed with fresh makeup hydrogen and combined with the HCR Reactor liquid feed stream.

## Table 2.1.4 HCR Operating Conditions

Reactor Type Number of Reactors Number of Beds/Reactor Catalyst per Bed

WHSV, HR<sup>-1</sup>
Hydrogen Chemical Consumption
Reactor Pressure (outlet)
H, Partial Pressure (outlet)
Hydrogen Recycle Rate SCF/BB1
Heat Release BTU/BB1
Catalyst Type

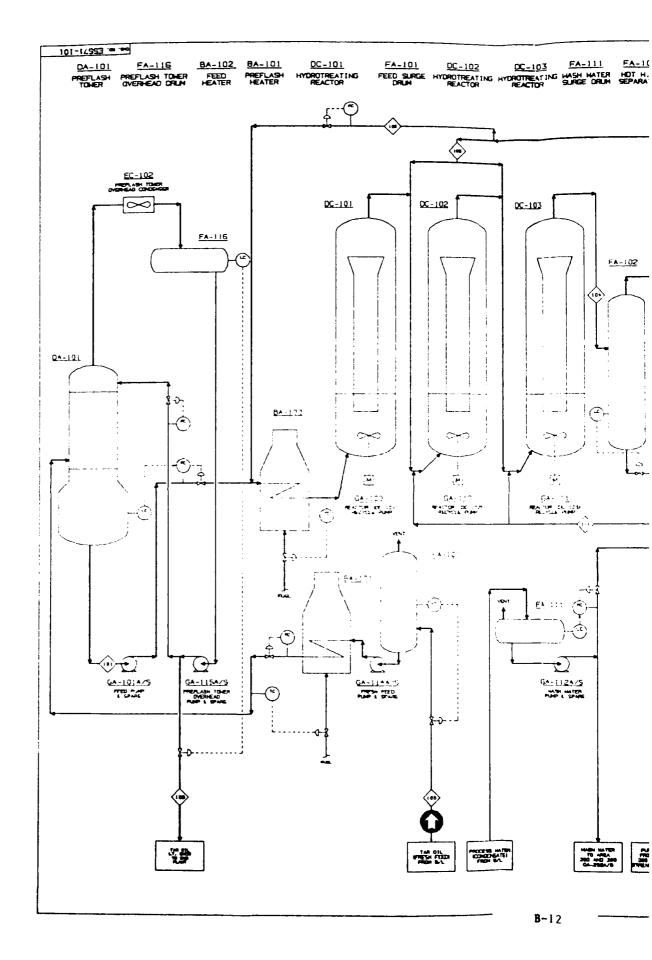
Fixed Bed 1 5 10% Bed 1 22.5 % Beds 2-5

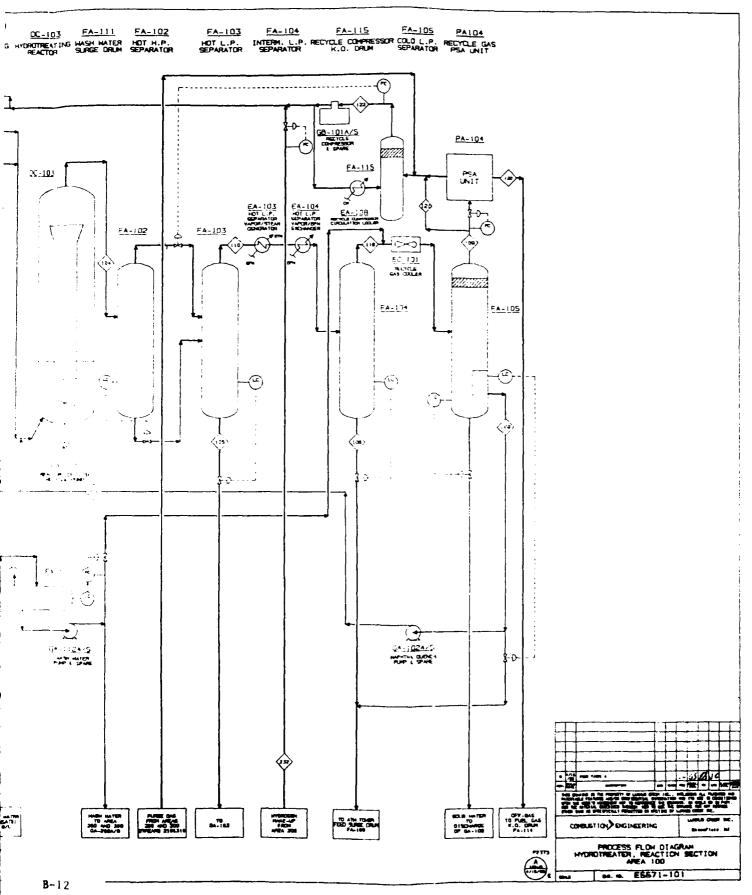
0.7 SCF/BB1 1123 1700 psia 1441 psia 6973 (excluding quench) 84806 Davison SMR 6-1881

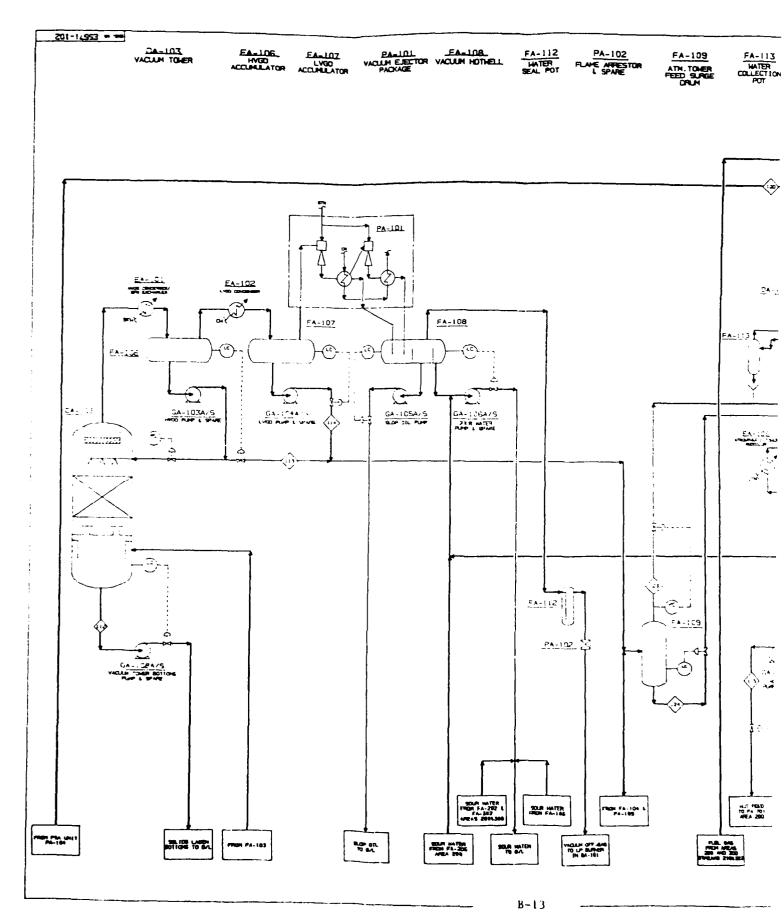
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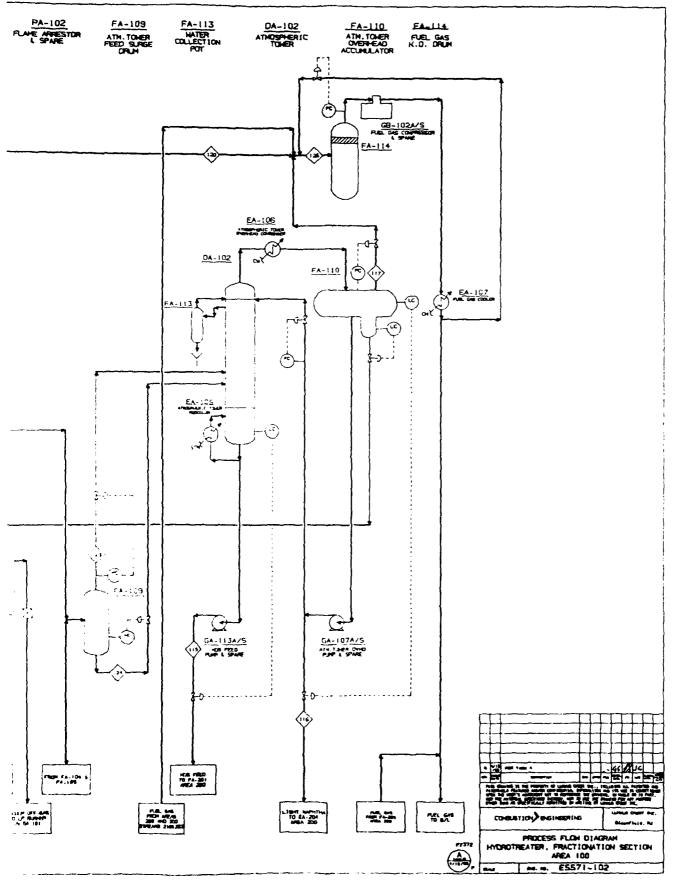
## 2.1.4 Process Flow Diagrams

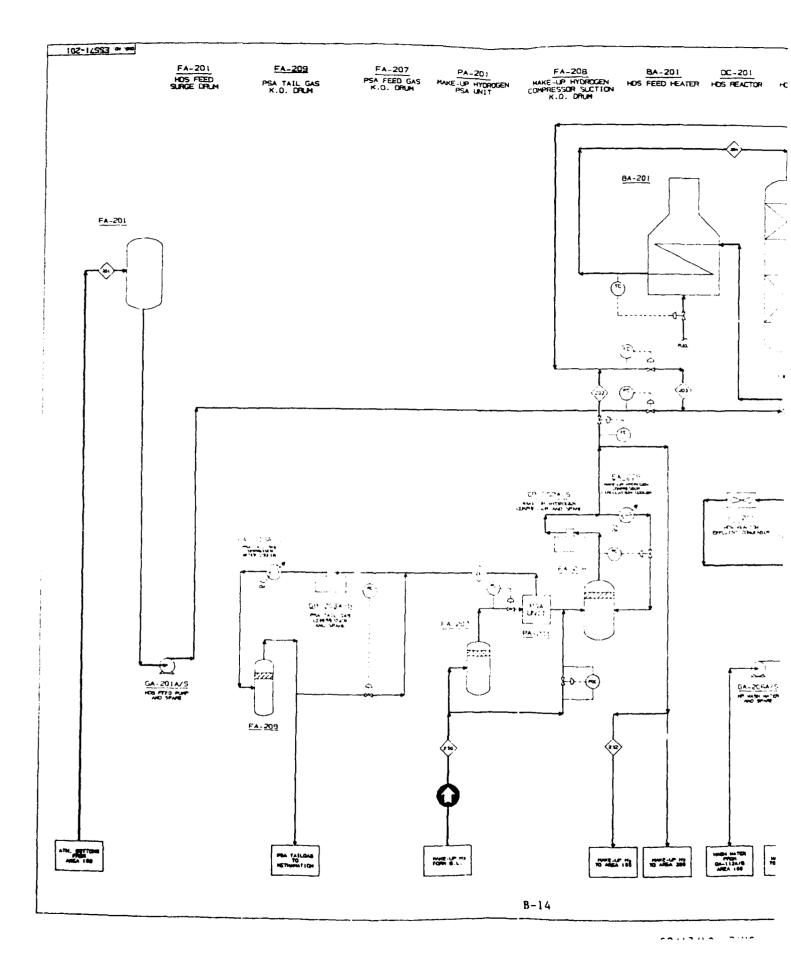
Dwg.	<u>Title</u>
E5571-101	Hydrotreater, Reaction Section
E5571-102	Hydrotreater, Fractionation Section
E5571-201	HDS, Reaction Section
E5571-202	HDS, Fractionation Section
E5571-301	Hydrocracker
SKB5571-103	PSA Unit (PA-104)
SKB5571-203	(PSA Unit`PA-201)

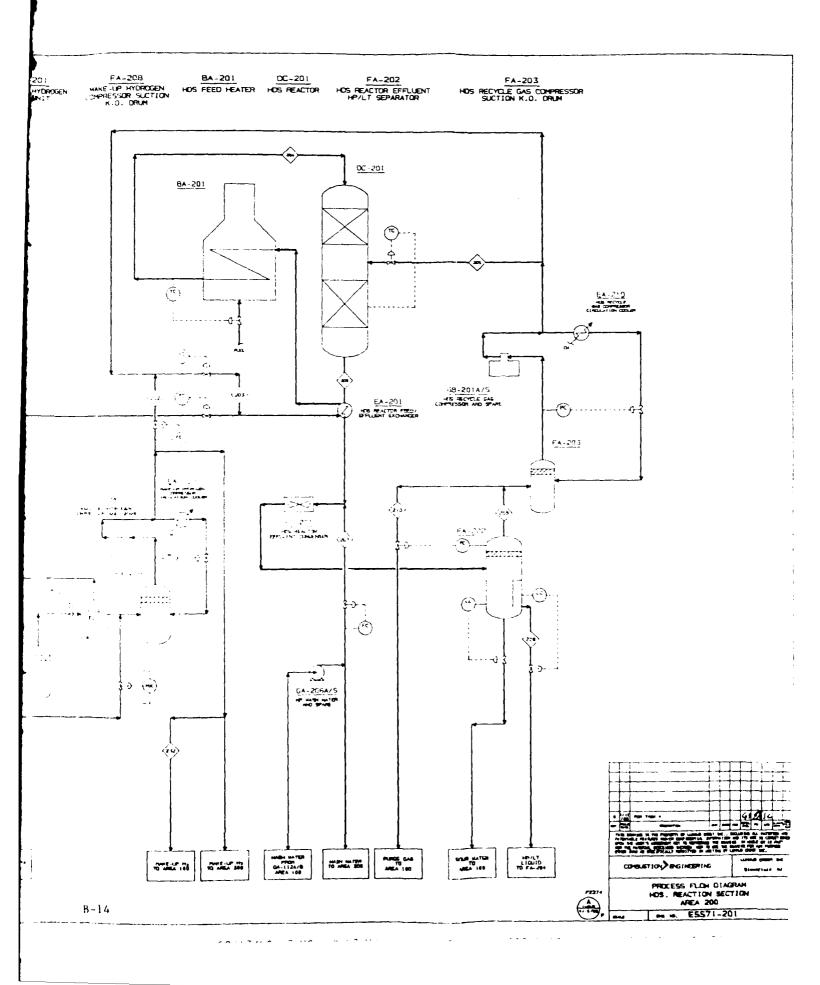


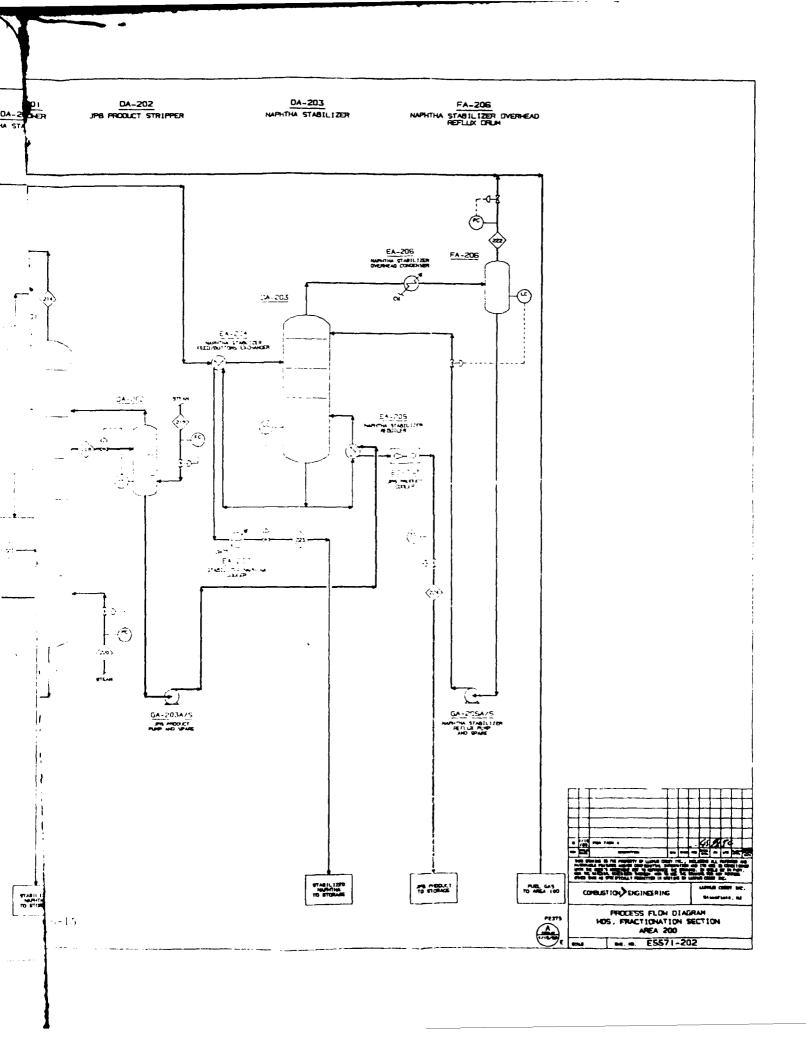


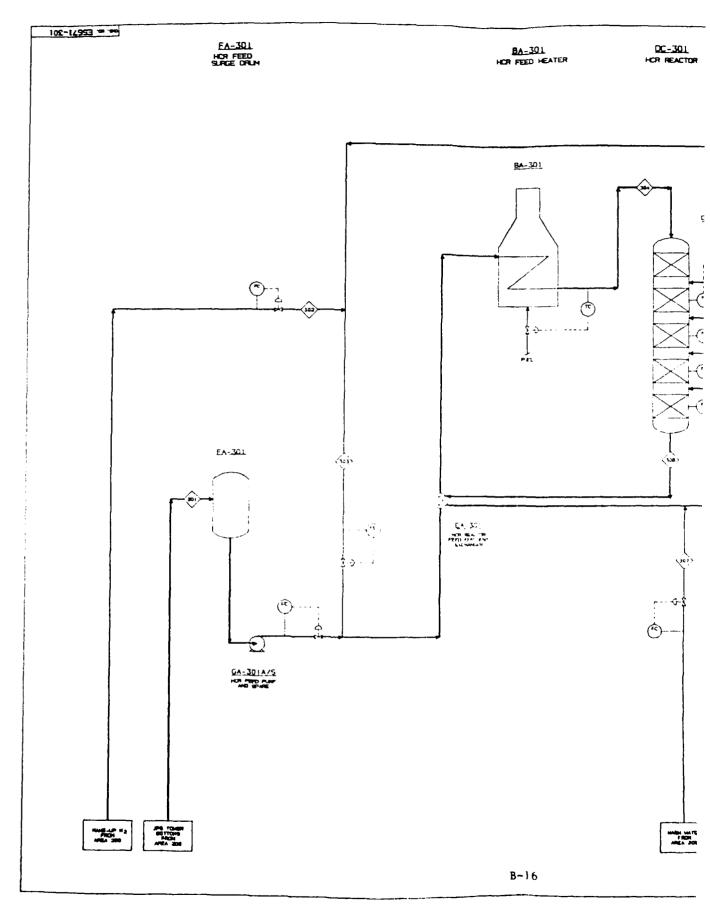


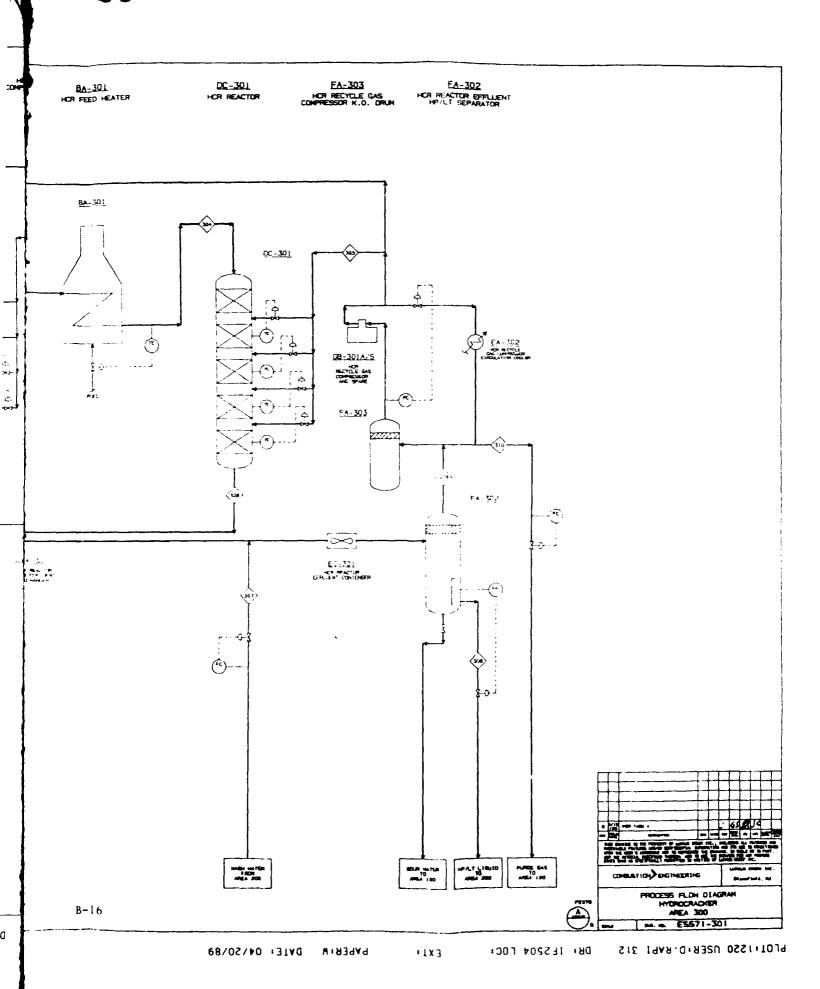


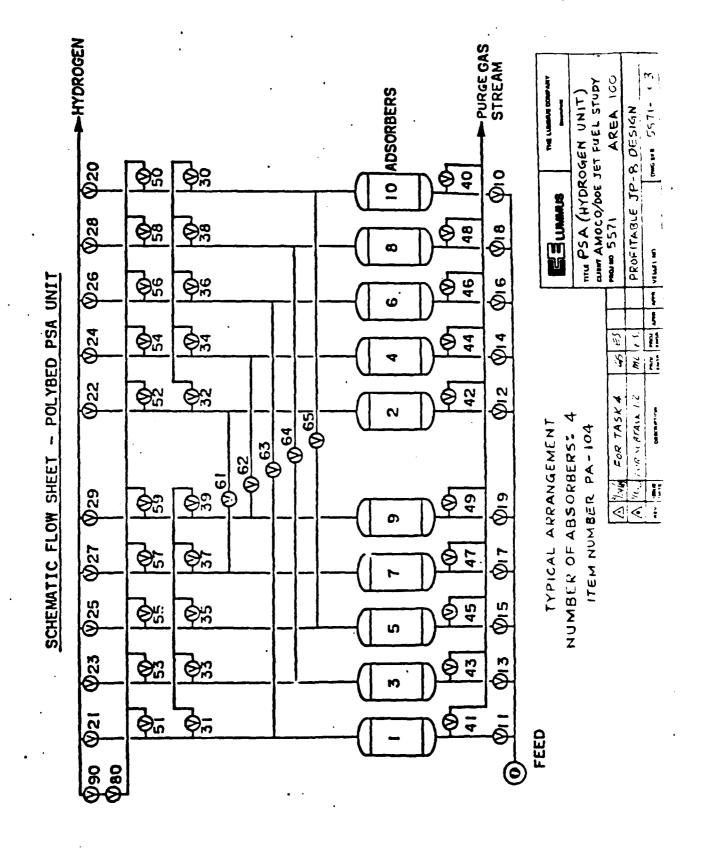


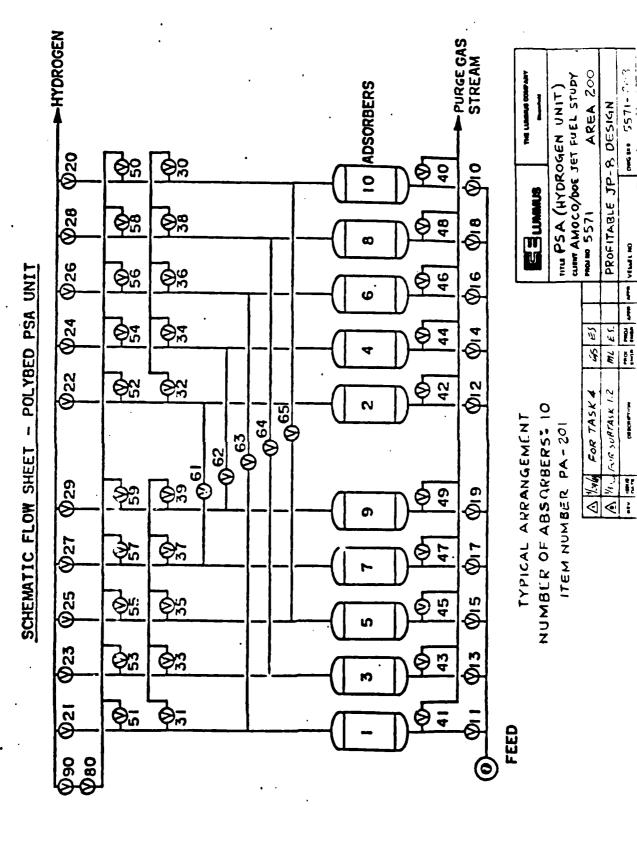












### LCI PROJECT 5571 TASK 4.0

# 2.1 Tar Oil Stream - cont'd

# 2.1.5 <u>Material Balances</u>

The following Material Balances were developed for Areas 100, 200 and 300.

DDE/AMCCO STUDY - 05571 FEED/PROCUCT SUMMARY SECTIONS 100,200,300

```
FEEDS
TAR OLL
SOURCE
GRALITY
SULPHUR
NITROGEN
OXYGEN
CARST
                                                                                  300 F+ COAL-DERIVED TAR DIL
6.4 API
4948 MPPM
                                                                                  6.4
4948
7291
54846
84.71
8.60
                                                                                                  WPPM
                                                                                                  W12
W12
W12
        MYDROGEN
       DISTILLATION, ASTM D 2887
0 VGL%
                                                                                   .5
                                                                                  279
371
414
         20
30
40
50
60
70
80
90
95
                                                                                  468
498
556
603
683
765
877
9-8
1018
        FLOW RATE
                                                                                   45763
                                                                                  3060
128
                                                                                                   BPSD
       TEMPERATURE AT B.L.
PRESSURE AT B. L.
    NYDROSEN MAKE UP
SOUPCE
COMPOSITION
                                                                                   FROM RECTISON UNIT
                                                                                   63.19
18.61
1.48
16.21
0.31
<0.01
0.19
<0.01
                                                                                               MOUR
MOUR
MOUR
MOUR
MOUR
MOUR
MOUR
MOUR
          ₽2
         CC2
CC2
C+--
          C2-±
         CCS, +2S, CS2
N2, AF
H2C
                                                                                   AS REQUIRED
        FLOW RATE
                                                                                   65
355
        TEMPERATURE
                                                                                                   P5:G
        PRESSURE
  PRODUCTS
STABILISED NAPHTHA
                                                                                   65.5
8512
813
                                                                                                   API
LB/H
BPSD
      GRAV: TY
      FLOW RATE
      ESTIMATED RVP
    JET FUEL (JP8)
                                                                                                    API
      FLOW RATE
                                                                                    32500
                                                                                                   LB/H
                                                                                   2662
100
-70
      ESTIMATED FLASH POINT ESTIMATED POUR PCINT DISTILLATION, ASTM D-86
        0
                VOL %
                                                                                    298
                                                                                    313
323
366
408
449
492
512
547
               VOL %
        10 VOLX
30 VOLX
50 VOLX
70 VOLX
90 VOLX
95 VOLX
100 VOLX
```

jet fig patiet JaB 5571 MTL BAL - ATERS 100, 200, 300 DOE/AMOCO STUDY - 05571 SECTIONS 100,200,300 YIELD SUMMARY

	LC-FINING	AIFTO			• • • • • • • • •	
	WT%	VOL %	API	SP.GR.	LB/H	BPSD
FEED						
18P-550	49.50	51.89	12.78		22652.78	
550+	50.00	47.86	0.25		22881.60	
SOLIDS	0.50	0.26		2.00	228.82	7.85
	100.00	100.00	6.15	1.03	45763.20	3054.62
PRODUCTS						
H2S	0.49				224.24	
NH3	0.83				379.83	
H20	5.74				2626.81	
C1	0.59				270.00	
CZ	0.47				215.09	
c3	0.39				178.48	
C4	0.36	0.63		0.58	164.75	19.36
C5	0.94	1.53		0.63	430.17	46.76
E6-200	2.86	3.98	60.00	0.74	1308.83	121.54
200-550	59,16	71.57	35.00	0.85	27073.51	2185.99
550+	32.23	34.30	15.00	0.97	14749.48	1047.77
SOLIDS	0.48	0.25		2.00	219.66	7.54
	104.54	112.26			47840.85	3428.96
£4÷	96.03	112.26	29,41	0.88	43946.40	3428.96
C5+	95.67	111.62	29,10	0.88	43781.65	3409.60
C6+	94.73	110.09	28.47	0.88	43351.48	3362.84
200+	91.87	106.11	27.49		42042.65	
EHEMICAL NZ CONSUMPTION :	3072.98	SCF/88.				
CONTERRIOR (ERLY)	35 56					

CONVERSION (550+) : 35.54 WT%

JE FUEL STUDY 143 5771 Melitar Allan 1CL 200,300

DOE/AMOCO STUDY-05571 DOE/AMOCO STUDY-05571 SECTION 100 - LC-FINING MATERIAL BALANCE

STREAM ID	100	101	102	103	104.1	104.2	104	105	106
STREAM NAME	TAR OIL	FRESH		QUENCH	RX EFFL.	RX EFFL.	REACTOR	LP/HT	LP/MT
	FEED	FEED	TO 1ST RX	GASES	VAPOR	LIQUID	EFFLUENT	LIQUID	LIQUID
PHASE	LIQUID	LIGUID	VAPOR	VAPOR	VAPOR	LIQUID	MIXED	LIQUID	LIQUID
OMPOSITION, LEMOLS/H							<del></del>	_	
N20			0.98	0.57	146.20	4.24	150.44	0.74	3.47
NH3					22.89	0.45	23.34	0.05	0.22
H2S					6.59	0.13	6.72	0.01	0.06
MZ			1390.51	808.68	1156.39	13.63	1170.02	0.81	2.58
C1			4.47	2.60	23.70	0.33	24.03	0.03	0.09
C2 C3			1.75	1.02	9.90	0.18	10.08	0.02	0.07
C3			0.84	0.49	5.57	0.12	5.69	0.02	0.06
C4			0.39	0.23		0.10	3.93	0.02	0.07
CS CS			0.41	0.24	7.78	0.24	8.02	0.05	0.21
150 F NBP			0.22	0.13	10.35	0.38	10.73	0.09	0.43
180 F NBP			0.12	0.07	9.34	0.37	9.71	0.09	0.47
212.5 F NBP			0.12	0.07	18.50	0.80	19.30	0.22	1.17
237.5 F NBP			0.08	0.04	19.19	0.89	20.08	0.27	1.46
262.5 F NBP			0.05	0.03	21.70	1.09	22.79	0.35	2.00
312.5 F NBP			0.04	0.02	62.92	3.76	66.68	1.41	8.60
387.5 F NBP					48.03	3.80	51.83	1.79	11.79
462.5 F NBP					35.70	3.83	39.53	2.20	14.90
512.5 F NBP					9.85	1.31	11.16	0.85	5.51
537.5 F NBP					7.79	1.16	8.95	0.79	4.92
600 F NBP					19.53	3.92	23.45	3.00	15.59
700 F NBP					11.56		15.41	3.35	11.09
800 F NBP					6.14	3.55	9.69	3.32	6.23
900 F NSP					2.85		5.87	2.94	2.92
1000 F NBP					0.02		0.07	0.05	0.02
LCF FEED		242.40				0.09	• • • • • • • • • • • • • • • • • • • •	0.09	V
TOTAL FLOW LEMOL/H	278.43				1666.32		1717.52	22.56	93.93
LB/H	47670.00	45763.20	3095.80	1800.50	50559.40	7255.10	57814.50	5383.50	17880.20
TEMPERATURE, DEG.F	128.00	414.00	268.00	268.00			760.00	745.00	500.00
PRESSURE, PSIG	35.00	6.10	2245.00	2245.00	2210.00	2210.00	2210.00	385.00	330.00
MOLECULAR WEIGHT	171.21	188.79	2.21	2.21	30.34	141.45	33.66	238.63	190.36
GRAVITY, DEG. API	7.90	6.40				27.00		16.10	22.00
VAPOR FLOW, MISCFD			12.75	7.42	15.18				44.00
LIQUID FLOW, BPSD	3222.35	3060.17				557.62		385.31	1330.90
DENSITY AT P,T, LB/FT3	62.50	54.54	0.60	0.60	5.02	38.83		40.06	45.85
VISCOSITY AT P.T. CP	5.80	1.50		0.01				0.18	0.27
VAPOR COMPRESSIBILITY	2.00		1.07	1.07					
CONDUCTIVITY, BTU/H.F.FT	0.07	0.06		0.10				0.05	0.05
SURFACE TENSION, DYNE/CM	36.00	25.00		7.10	2.00	7.01		4.87	
VAPOR FLOW AT P,T, ACFN			86.47	50.29	167.76				
LIQUID FLOW AT P,T, USGPM	95.19	104.72				23.32		16.77	48.67
ENTHALPY, MMBTU/H	-1.37	10.49	-0.78	-0.45	27.75	2.79	30.54	1.86	3.41

JET FUEL STUT JOB 5571 MTL. BAL AZEA) 100 Zau, 3-0

DOE/AMOCO STUDY-05571 DOE/AMOCO STUDY-05571 SECTION 100 - LC-FINING MATERIAL BALANCE

STREAM ID	108	109	110	111	112	113	114	115	116	117
STREAM NAME	LP/LT LIQUID	LP/LT VAPOR	LP/HT VAPOR	NAPHTHA QUENCH	VAC.TWR BOTTOMS	VAC.TWR DIST.#1	VAC.TWR DIST.#2	ATM.TUR BOTTOMS	LIGHT NAPHTHA	ATM.TWR O/H GAS
PHASE	LIQUID	VAPOR	VAPOR	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	VAPOR
COMPOSITION, LBMOLS/H			<del></del>							
и20	11.53	5.16	149.69	2.97			0.07	0.02	6.70	5.62
NH3	4.03		23.29	1.04					0.27	2.95
H2S	0.72		6.70	0.18					0.03	0.56
HŽ	3.21	1163.42	1169.21	0.83						4.96
<b>c</b> 1	0.35	23.57	24.01	0.09						0.35
C2 C3	0.74	9.25	10.06	0.19					0.01	0.61
C3	1.17	4.45	5.68	0.30					0.06	0.87
C4	1.77	2.08	3.92	0.46					0.26	1.13
C5	5.58	2.18	7.98	1.44				0.02	1.71	2.64
150 F NBP	9.03	1.19	10.64	2.32	•		0.02	1.60	3.80	1.79
180 F N8P	8.52	0.62	9.62	2.19			0.04	5.09	1.41	0.38
212.5 F NBP	17.26	0.65	19.08	4.44			0.13	13.79	0.35	0.05
237.5 F NBP	17.96	0.40	19.82	4.62			0.19	14.99	0.06	0.01
262.5 F NBP	20.19	0.26	22.45	5.20			0.28	17.33	0.01	
312.5 F NBP	56.44	0.23	65.27	14.53		0.03	1.30	51.93		
387.5 F NBP 462.5 F NBP	38.22	0.02		9.84		0.09	1.68	41.96		
512.5 F NBP	22.42		37.32	5.77	0.01	0.27	1.92	33.75		
537.5 F NBP	4.80		10.31 8.16	1.24		0.19	0.66	9.93		
600 F NBP	3.23 4.85		20.44	0.83	0.07	0.23	0.56	8.11		
700 F NBP	0.97		12.06	1.25 0.25	0.03	1.55	1.42	22.16		
800 F NBP	0.13		6.36	0.03	0.11	2.76 2.84	0.48 0.08	15.04		
900 F NBP	0.13		2.93	0.03	0.40 1.37	1.57		9.24		
1000 F NBP	0.01		0.02			1.5/	0.01	4.50		
LCF FEED			0.02		0.04 0.09			0.03		
LCF FEED					0.09					
TOTAL FLOW LEMOL/H	233.13 27802.00		1695.06 52430.90	60.01 7155.00	2.05	9.53	8.84	249.49	14.67	21.92
LB/H					<del>96</del> 2.10	2821.80	1530.00	41496.80	744.70	684.00
TEMPERATURE, DEG.F	110.00	110.00	740.00	132.00	599.00	400.00	100.00	410.00	120.00	120.00
PRESSURE, PSIG	310.00	310.00	385.00	2310.00	-13.00	85.00	-13.00	27.30	150.00	20.30
MOLECULAR WEIGHT	119.26	3.20	30.93	119.23	469.32	296.10	173.08	166.33	50.76	31.20
GRAVITY, DEG. API	40.60			40.60	5.10	12.40	26.30	28.70	59.00	5,,,,
VAPOR FLOW, MMSCFD		11.05	15.44		20.0			201.0	27.00	0.20
LIQUID FLOW, BPSD	2320.18			597.11	63.73	196.90	117.07	3223.61	68.79	
DENSITY AT P,T, LB/FT3	50.01	0.17	0.96	50.10	53.39	53.99	54.89	45.54	44.64	0.18
VISCOSITY AT P,T, CP	0.75	0.01	0.02	0.79	1.42	0.93	2.06	0.28	0.28	0.01
VAPOR COMPRESSIBILITY		1.01	1.00	,	1.46	0.73	2.00	0.20	0.20	0.98
CONDUCTIVITY, BTU/H.F.FT	0.07	0.07		0.07	0.04	0.05	0.07	0.05	0.09	0.01
SURFACE TENSION, DYNE/CM	24.84			23.59	18.60	23.27	30.79	14.11	21.57	0.0,
VAPOR FLOW AT P.T. ACFM		384.37	907.99							63.40
		J	,0,.,,							05.40
	RF. 93			17.82	2 25	Æ 52	<b>7 49</b>	113 73	2 08	
LIQUID FLOW AT P,T, USGPM	69.38			17.82	2.25	6.52	3.48	113.73	2.08	

JET FLE STOT JOB 5571 MTL BAL ALIA! 100, ZOU, BLA DOE/AMOCO STUDY-05571 DOE/AMOCO STUDY-05571 SECTION 100 - LC-FINING MATERIAL BALANCE

STREAM ID	118	120	121	122	123	124	125	126
STREAM NAME	LP/MT GASES	PSA Tail gas	PSA BY-PASS	TOT.GAS TO RX'S	ATM.TWR VAP.FEED		FUEL GASES	300F- TAR OIL
PHASE	VAPOR	VAPOR	VAPOR	VAPOR	VAPOR	LIQUID	VAPOR	LIQUID
COMPOSITION, LBMOLS/H	<del> </del>							
H20	146.22	3.61	1.55	1.55	0.16	12.18	10.43	
ин3	23.08				0.17	3.04	3.35	
H2S	6.65				0.04	0.55	0.65	
H2	1166.63	81.44	349.02	2199.18	1.97	3.00	92.92	
C1 .	23.92	16.50	7.07	7.07		0.28	23.44	
C2	9.99	6.47	2.77	2.77	0.05	0.57	12.89	
C3	5.62	3.12	1.34	1.33	0.04	0.89	10.29	
C4	3.85	1.46	0.62	0.62	0.03	1.35	11.38	
C5	7.77	1.53	0.66	0.65		4.32	6.22	
150 F MBP	10.22	0.83	0.36	0.36		7.15	3.87	
180 F NBP	9.15	0.44	0.19	0.19		6.85	1.51	
212.5 F NBP	17.91	0.46	0.20	0.20		14.15	0.78	
237.5 F NBP	18.36	0.28	0.12	0.12		15.03	0.47	
262.5 F NBP	20.44	0.18	0.08	0.08		17.32	0.24	
312.5 F NBP	56.67	0.16	0.07	0.07		51.89	0.16	
387.5 F NBP	38.25	0.02	0.01	0.01	0.01	41.95	0.02	
462.5 F NBP	22.42					33.75		
512.5 F NBP	4.80					9.93		
537.5 F NBP	3.23					8.11		
600 F NBP	4.85					22.16		
700 F NBP	0.97					15.04		
800 F NBP	0.13					9.24		
900 F NBP	0.01					4.50		
1000 F NBP						0.03		
LCF FEED								
TOTAL FLOW LBMOL/H	1601.14	112.89	362.51	2212.65			178.62	26.57
LB/H	34550.80	1244.20	1166.50	4896.30	43.40	42881.90	3398.20	1907.00
TEMPERATURE, DEG.F	500.00	110.00	105.00	105.00			107.00	120.00
PRESSURE, PS1G	330.00	1.30	305.00	280.00	185.00	185.00	1.20	50.00
MOLECULAR WEIGHT	21.58	11.02	3.22	2.21	15.56	151.38	19.02	71.77
GRAVITY, DEG. API						30.30		43,90
VAPOR FLOW, MISCFD	14.58	1.03	3.30	20.15	0.03		1.63	
LIQUID FLOW, BPSD						3364.48		162.20
DENSITY AT P.T. LB/FT3	0.73	0.03	0.17	0.11	0.38	48.15	0.05	47,50
VISCOSITY AT P.T. CP	0.02	0.01	0.01	0.01			0.01	1.50
VAPOR COMPRESSIBILITY	1.00	1.00	1.01	1.01			1.00	
CONDUCTIVITY, BTU/H.F.FT	0.05	0.03	0.07				0.02	0.08
SURFACE TENSION, DYNE/CM	,	3.03		2.50		17.96		
VAPOR FLOW AT P.T. ACFM	792.41	741.39	117.05	765.53	1.89		1138.05	
LIQUID FLOW AT P.T. USGPH	176.41	741.37			,	111.15		5.01
PATHALBY MARTILLA	14.29	0.08	-0.53	·3.9 <sup>4</sup>	0.01	3.76	0.57	0.21
ENTHALPY, MMBTU/H	19.67	0.00	.0.33		. 5.01	3.10	V.31	ν.

JET FUEL 5-0" JUB 557/ MTL BAL A LETS 100, 200, 300

DOE/AMOCO STUDY - 05571 SECTIONS 100,200,300 YIELD SUMMARY

	HYDROTRE	ATING YIELD				
	WT%	VOL%	AP1	SP.GR.	LB/H	BPSD
FEED						
18P-550	64.50	67.38	35.01		26765.44	
550+	35.50	32.63	15.00	0.97	14731.36	1046.48
SOLIDS	0.00					
	100.00	100.00	27.90	0.89	41496.80	3207.60
PRODUCTS						
H2S	0.01				4.15	
NH3	0.02				8.30	
H20	0.11				45.65	
C1	0.61				253.13	
C2	0.44				182.59	
C3	0.35				145.24	
C4	0.15	0.23		0.58	62.25	7.31
C5	1.09	1.53		0.63		49.17
C6-200	2.50	3.00	60.00	0.74		96.34
200- <b>55 O</b>	65.83	69.58	37.00		27317.34	2231.95
55.0-F	29.93	28.46	20.10		12419.99	913.01
SOLIDS	•	••••		• • • • • • • • • • • • • • • • • • • •		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	101.04	102.81			41928.37	3297.77
C4+	99.50	102.81	33.21	0.86	41289.32	3297.77
C5+	99.35	102.59	33.09		41227.07	
C6+	98.26	101.05	32.43		40774.76	
200+	95.76	98.05	31.71		39737.34	3144.96
CHEMICAL H2 CONSUMPTION : CONVERSION (550+) :	607.87 15.69	SCF/BB.				

JET FUEL STUDY JUB 5571 MTL BML ACEAS 104, ZOC, 344

DOE/AMOCO STUDY-05571 SECTION 200 - HDS/JP8 DISTILLATION MATERIAL BALANCE

STREAM ID	201	202	203	204	205	206.1	206.2	206	207	208
STREAM NAME	FRESH FEED	MAKE-UP HYDROGEN	TOT.GAS TO RX	REACTOR FEED	HYDROGEN QUENCH	RX EFFL. VAPOR	RX EFFL. LIQUID	REACTOR EFFLUENT	WASH WATER	HP/LT
PHASE	LIQUID	VAPOR	VAPOR	MIXED	VAPOR	VAPOR	LIQUID	MIXED	LIQUID	LIQUID
COMPOSITION, LBMOLS/H										
N2										
co										
CO2										
H2O NH3			0.51	0.51	0.21		0.30	3.25	66.61	0.9
H2S			0.13 0.06	0.13 0.06	0.05 0.02		0.06	0.67		0.4
H2		306.73	611.02	611.02			0.02 <b>39.3</b> 3	0.20 640.51		0.1 <b>3</b> 0.1
C1		300.73	32.92	32.92	13.20		4.39	61.90		10.5
C2			3.94	3.94	1.58		1.00	11.59		5.3
C3			0.82	0.82			0.44	4.45		3.1
C4			0.10	0.10	0.04	1.07	0.14	1.21		1.0
C5			0.23	0.23	0.09		0.85	6.59		6.2
150 F NBP			0.08	0.08		4.44	0.76	5.20		5.09
180 F NBP			0.06	0.06			1.09	7.04		6.9
212.5 F NBP			0.03	0.03		5.31	1.05	6.36		6.3
237.5 F NBP			0.03	0.03		8.10	1.70	9.80		9.7
262.5 F NBP 312.5 F NBP			0.02 0.03	0.02		8.96	2.02	10.98		10.9
387.5 F NBP			0.03	0.03 0.01		26.86 30.55	6.98	33.84 40.66		33.89 40.65
462.5 F NBP			0.01	0.01		30.02	10.11 12.95	40.00		40.6
512.5 F NBP						9.02	4.71	13.73		13.7
537.5 F NBP						10.68	6.15	16.83		16.8
600 F NBP						11.70	8.73	20.43		20.4
700 F NBP						5.59	6.49	12.08		12.0
800 F N8P						2.18		6.26		6.26
900 F NBP						0.94	3.00	3.94		3.95
HD\$ FEED	249.49			249.49						
TOTAL FLOW, LBMOL/H	249.49	306.73	649.99	899.48	260.60		116.35	960.49	66.61	287.7
LB/H	41496.80	618.40	1976.60	43473.40	792.50	29567.50	14696.20	44265.90	1200.00	41837.2
TEMPERATURE, DEG.F	410.00	100.00	108.00	740.00	109.00	760.00	760.00	760.00	120.00	120.0
PRESSURE, PSIG	35.00	2535.00	2469.00	2405.00					2354.00	
MOLECULAR WEIGHT	166.33	2.02	3.04	48.33	3.04	35.03	126.31	46.09	18.02	145.4
GRAVITY, DEG. API	28.70				• • • • • • • • • • • • • • • • • • • •		40.50			38.4
VAPOR FLOW, MMSCFD		2.79	5.92		2.37	7.69				
LIQUID FLOW, BPSD	3223.61						1225.74		76.52	3446.84
DENSITY AT P.T. LB/FT3	45.53	0.79	1.15		1.12	6.11	42.18		61.71	51.4
VISCOSITY AT P,T, CP	0.28	0.01	0.01		0.01		0.14		0.56	1.3
VAPOR COMPRESSIBILITY		1.08	1.08		1.08					
CONDUCTIVITY, BTU/H. F. FT	0.05	0.09	0.08		0.68	0.01	0.11		0.37	0.0
SURFACE TENSION, DYNE/CM	14.11						43.44		68.25	22.5
VAPOR FLOW AT P.T. ACFM		13.00	28.68		11.82	80.60				
THE ON I COM MITTING										
LIQUID FLOW AT P,T, USGPH	113.74						43,49		2.43	101.5

JET FUEL STUD"

JOB 5571

MTL 3M AREM

144, 244, 3--

DOE/AMOCO STUDY-05571 SECTION 200 - HDS/JP8 DISTILLA MATERIAL BALANCE

STREAM ID	209	210	211	212	213.1	213.2	213	214	215	216
STREAM NAME	HP/LT VAPOR	PURGE GASES	LP/LT VAP TO FUEL	JP8 TWR FEED	JPS HTR VAPOR	JP8 HTR Liquid	JP8 HTR OUTLET	JP8 TWR O/H GAS	JP8 TWR REFLUX	JPS TUR
PHASE	VAPOR	VAPOR	VAPOR	L10010	VAPOR	LIQUID	MIXED	VAPOR	LIQUID	VAPOR
COMPOSITION, LBMOLS/H				·						
N2										
CO CO2										
H20	0.81	0.08	0.22	1.03	1.03	0.00	1.03	82.74	1.12	1,19
NH3	0.21	0.02	0.05	0.40	0.40	0.00	0.40	0.40		0.40
HZS	0.09	0.01	0.02	0.09	0.09	0.00	0.09	0.09		0.09
H2	610.31	61.03	39.05	6.52	6.52	0.00	6.52	6.99	0.47	6.47
C1	51.39	5.14	8.65	6.59		0.00	6.59	7.99	1.40	6.44
C2	6.21	0.62	1.60	5.80		0.00	5.80	11.89	6.09	5.15
C3	1.32	0.13	0.66	8.40	8.38	0.02	8.40	11.08	4.68	5.90
C4	0.16	0.02	0.46	19.82	19.80	0.02	19.82	128.72	108.90	8.19
C5	0.38	0.04	0.11 0.06	10.79 17.32	10.78 17.27	0.01 0.05	10.79	93.38 167.58	82.59	1.97
150 F MBP 180 F MBP	0.12 0.10	0.01 0.01	0.06	17.00		0.05	17. <b>32</b> 17.00	169.10	150.28 152.16	1.25
212.5 F NBP	0.10	0.01	0.02	13.15		0.04	13.15	131.57	118.63	0.27
237.5 F NBP	0.05	0.01	0.01	16.14		0.05	16.14	150.45	135.77	0.18
262.5 F NBP	0.04		0.01	16.93		0.08			76.12	0.06
312.5 F NBP	0.04			53.21	52.85	0.36		2.49	2.25	
387.5 F NBP	0.01			59.10	58.42	0.68	59.10	1.04	0.94	
462.5 F NBP				64.26						
512.5 F NBP				19.73		0.62				
537.5 F NBP				19.66		0.75				
600 F NBP				30.03		1,92				
700 F NBP				17.20						
800 F MBP 900 F MBP				9.79 5.78						
HDS FEED				3.70	2.05	0.00				
TOTAL FLOW, LBMOL/H	671.29	67.13		418.74					841.40	38.25
LB/H	2399.60	240.00	346.50	64546.00	59556.30	4989.70	64546.00	85484.70	74690.40	1389.20
TEMPERATURE, DEG.F	120.00	120.00	120.00	120.00	650.00	650.00	650.00	248,00	100.00	100.00
PRESSURE, PS1G	2335.00	2335.00		335.00					15.30	15.30
MOLECULAR WEIGHT	3.57	3.58	6.80	154.14	147.84	314.02	154.14	81.43	88.77	36.32
GRAVITY, DEG. API	••••			38.60		26.30			67.50	50.54
VAPOR FLOW, MMSCFD	6.11	0.61	0.46		3.67			9.56		0.35
LIQUID FLOW, BPSD				5324.00		381.81			7207.47	
DENSITY AT P.T. LB/FT3	1.25	1.25	0.38	50.53	0.66	43.49		1.32	43.06	0.19
VISCOSITY AT P,T, CP	0.01	0.01		1,12	0.01	0.27		0.02		0.01
VAPOR COMPRESSIBILITY	1.08	1.08			0.94			0.99		0.98
CONDUCTIVITY, BTU/H.F.FT SURFACE TENSION, DYNE/CM	0.07	0.07	0.07	0.07 24.18		0.04 14.45		0.03	0.07	0.01
VAPOR FLOW AT P.T. ACFM	32.05	3.21	15.16		1503.95			1078.54		123.81
LIQUID FLOW AT P,T, USGPM	<del>-</del>			159.42		14.32			216.45	
FUTUAL DE AMERICA	. 0. 02			0.43	3/ ==		34.34	14 47	0.50	0.35
ENTHALPY, MMBTU/H	·0.92	-0.09	-0.03	0.43	24.77	1.58	26.34	16.83	0.50	0.25

JET FUEL STUDY JUB 5571 UTL BAL AZEAS 100, ZIU BLA DOE/AMOCO STUDY-05571 SECTION 200 - HDS/JPB DISTILLA MATERIAL BALANCE

STREAM ID	217	218	219	220	221	222	223	224	230	231
STREAM NAME	JP8 TWR O/H LIQ	JP8 STRP.	JP8 STRP.	JPS TWR S.STEAM			STABIL'D NAPHTHA	JP8 PRODUCT	MAKEUP HZ PSA FEED	
PHASE	LIQUID	LIQUID	VAPOR	VAPOR	Ltauto	VAPOR	LIGUID	Liquib	VAPOR	VAPOR
COMPOSITION, LBMOLS/H										
N2									5.97	5.97
00									585.01	585.01
CO2 N2O	0,12	0.18	51,71	30.00	0.83	0.01			46.52 0.32	46.52 0.32
N20 NH3	U. 12	U. 18	31,71	30.00	0.03	0.01			0.32	0.32
H2S										
H2	0.03	0.01				0.05			1986.38	278.09
c1	0.15	0.02				0.15			509.56	509.56
C2	0.65	0.04				0.66			9.74	9.74
<b>c3</b>	2.50	0.09				0.40	0.16			
C4	11.63	0.40				0.60	11.29			
CS CS	8.83	0.39				0.08	10.45			
150 F NBP	16.04	1.14					19.85	0.02		
180 F NBP	16.26	1.64					17.66	0.06		
212.5 F NBP	12.68	2.51					13.02	0.21		
237.5 F NBP	14.53	9.17					14.56	1.46		
262.5 F NBP	8.12	31.85			0.01		8.14	8.73		
312.5 F NBP	0.27				0.08		0.24	52.89		
387.5 F NBP		70.75			0.66		0.10	58.34		
462.5 F NBP		62.96			5.45			58.82		
512.5 F NBP		13.78			6.40			13.32		
537.5 F NBP		8.87			11.00			8.66		
600 F MBP		2.62			27.58 17.19			2.57		
700 F NBP		0.01			9.79					
800 F NBP					5.78					
900 F NBP HDS FEED					7.10					
TOTAL FLOW, LBMOL/H	91.81	302.10	51.71	30.00	84.77	1.95	95.47	205.08	3143.50	1435.22
LB/H		44763.20			22680.00				31077.00	
TEMPERATURE, DEG.F	100.00	394.00	650.00	650.00	562.00	100.00	100.00	120.00	65.00	75.00
PRESSURE, PSIG	135.00			85.00	23.50					5.00
, KE330AE, 1316	, 6, 7, 1, 1		03.00	02110					••••	
MOLECULAR WEIGHT	86.93	148.17	18.02	18.02	267.55	41.44	89.16	158.47	9.89	19.25
GRAVITY, DEG. API	67.50				22.90		65.50		)	
VAPOR FLOW, MMSCFD						0.02	)		28.63	13.07
LIQUID FLOW, BPSD	770.18	3724.80			1698.07	•	813.17	2661.81		
DENSITY AT P,T, LB/FT3	43.06	42.00	0.15	0.15	45.54	0.85	43.24	51.15	0.65	0.07
VISCOSITY AT P.T. CP	0.31			0.02						
VAPOR COMPRESSIBILITY			2.02			0.98			1.00	1.00
COMDUCTIVITY, BTU/H.F.FT	0.07	0.05	0.03	0.03	0.04		_	0.07	•	
SURFACE TENSION, DYNE/CH	18,49				13.49		18.20			
VADOR FLOW AT R T APEN			101.48	58.88		1.59	,		704.02	6859.38
VAPOR FLOW AT P,T, ACFM LIQUID FLOW AT P,T, USGPM	23.13	133.01		20.00	62.16		24.57	79.30		5077.50
• •										
ENTHALPY, MMSTU/H	0.05	6.90	1.26	0.73	5.61	0.0	0.06	0.11	•	

JET FUEL STUDY LOB 5571 MTC BAL A 26AS 10C, ZOS 3CO DOE/AMOCO STUDY-05571 SECTION 200 - HDS/JP8 DISTILLA MATERIAL BALANCE

STREAM ID	232
STREAM NAME	MAKEUP H2 TO LCF
PHASE	VAPOR
COMPOSITION, LBMOLS/H M2 CO CO2 H2O MH3 H2S C1 C2 C3 C4 C5 150 F MBP 180 F NBP 212.5 F MBP 237.5 F MBP 242.5 F MBP 357.5 F MBP 512.5 F MBP 537.5 F MBP 537.5 F MBP 537.5 F MBP 600 F MBP 700 F MBP 700 F MBP 800 F MBP	1117.22
HDS FEED	
TOTAL FLOW, LBMOL/H LB/H	1117.22 2251.19
TEMPERATURE, DEG.F PRESSURE, PSIG	65.00 2505.00
MOLECULAR WEIGHT GRAVITY, DEG. API	2.02
VAPOR FLOW, MMSCFD LIQUID FLOW, BPSD	10.18
DENSITY AT P,T, LB/FT3 VISCOSITY AT P,T, CP	0.97
VAPOR COMPRESSIBILITY CONDUCTIVITY, BTU/H.F.FT SURFACE TENSION, DYNE/CM	1.08
VAPOR FLOW AT P,T, ACFM LIQUID FLOW AT P,T, USGPM	38.50
ENTHALPY, MMBTU/H	

JET FUEL STUDY JOB 5571 NTL BAL ARCAS 100, ZOL 3CC DOE/AMOCO STUDY - 05571 SECTIONS 100,200,300 YIELD SUMMARY

	HYDROCRAC	KING YIELD		*******		
	WTX	VOL %	AP1	SP.GR.	LB/H	BPSD
FEED				<del></del>		
18P - 550 550+			22.60		22680.00	1697.9
SOL IDS	100.00	100.00	22.89	0.92	22000.00	1097.9
	100.00	100.00	22.89	0.92	22680.00	1697.9
PRODUCTS						
H2S	0.00				0.00	
N=3	0.00				0.00	
H20	0.02				4.54	
<b>C1</b>	0.50				113.40	
CS.	0.30				68.04	
<b>C3</b>	1.20				272.16	
C4	5.00	7.85		0.58		133.2
C5	1.50	2.18		0.63		36.9
C6-200_	8.50	10.98	68.00	0.71	1927.80	186.4
200.535	57.50	63.87	40.00	0.83		1084.4
\$0110\$	27.34	27.71	25.00	<b>0.9</b> 0	6200.71	470.5
	101.86	112.59			23101.85	1911.7
C4+	99,84	112.59	42.61	0.81	22643.71	1911.7
C5+	94.84	104.74	39.01	0.83	21509.71	1778.5
C6+	93.34	102.56	38.15	0.83	21169.51	1741.5
200+	84.84	91.58	35.16	0.85	19241.71	1555.0
CHEMICAL H2 CONSUMPTION : CONVERSION (\$1.5-) :	1122,42 72,66					

JET FUEL STUDY JOB 5571 MTL BAL AZEAS 100, ZOU, 310 DOE/AMOCO STUDY-05571
SECTION 300 - HYDROCRACKING
MATERIAL BALANCE
DOE/AMOCO STUDY-05571
SECTION 300 - HYDROCRACKING
MATERIAL BALANCE

STREAM ID	301	302	303	304	305	306.1	306.2	306	307	308
STREAM NAME	FRESH FEED	MAKE-UP HYDROGEN	TOT. CAS	REACTOR FEED	HYDROGEN QUENCH	RX EFFL. VAPOR	RX EFFL. LIQUID	REACTOR EFFLUENT	WASH WATER	MP/LT
PHASE	FIGNID	VAPOR	VAPOR	MIXED	VAPOR	VAPOR	FIGNID	MIXED	LIQUID	LIQUID
COMPOSITION, LBMOLS/H								<u>-</u>		<del></del>
H20			0.92	0.92	0.85	2.02		2.02	0.05	0.28
NH3										
H2S		~	1192.49	1192.49	4404 37	3001 1/		2004 74		40.00
H2 C1		253.53	78.42	78.42	1106.27 72.75	2091.16 158.18		2091.76 158.25		15.38 4.73
C2			7.86	7.86	7.29			17.41		2.03
<b>C3</b>			8,18	8.18	7.59	21.92		21.93		5.93
č4			9.47	9.47	8.78			37.76		19.23
C5			0.88	0.88	0.81			6.40		4.69
150 F MBP			0.92	0.92	0.86	14.07	0.02	14.10		12.29
180 F NBP			0.45	0.45	0.42	10.96	0.02	10.98		10.10
212.5 F NBP			0.17	0.17	0.16			7.20		6.86
237.5 F NBP			0.10	0.10	0.09			6.59		6.40
262.5 F NBP			0.06	0.06	0.05			6.11		5.99
312.5 F NBP			0.07	0.07				19.55		19.41
387.5 F NBP			0.01	0.01	0.01			18.48		18.45
462.5 F NBP						21.12		21.30		21.29
512.5 F NBP 537.5 F NBP						5.93 2.79		6.00		6.00
600 f NBP						9.38		2.83 9.60		2.83 9.60
700 F NBP						4.88		5.13		5.13
800 F NBP						3.14				3.53
900 F NBP						1.37				1.83
HCR FEED	84.77			84.77			0.40			
TOTAL FLOW, LBMOL/H	84.77	253.53	1300.00	1384.77	1205.99	2466.16	2.60	2468.76	0.05	181.98
LB/H	22680.00	511.10	5051.80	27731.80	4686.60	31835.80	587.30	32418.40	0.90	23055.30
TEMPERATURE, DEG.F	300.00	100.00	118.00	650.00	118.00	670.00	670.00	670.00	120.00	120.00
PRESSURE, PSIG	35.00	1835.00	1835.00	1715.00	1835.00	1685.00	1685.00	1685.00	1686.00	1635.00
MOLECULAR WEIGHT	267.55	2.02	3.89	20.03	3.89	12.91	225.88	13.13	18.00	126.69
GRAVITY, DEG.API	22.90						30.75			47.80
VAPOR FLOW, MMSCFD		2.31	11.84		10.98	22.46				
LIGUID FLOW, BPSD	1698.07						46.21			2004.55
DENSITY AT P.T. LB/FT3	51.10	0.66	1.24		1.24	1.73	40.26	ı	61.71	48.32
VISCOSITY AT P.T. CP	1.70	0.01	0.01		0.01				0.56	
VAPOR COMPRESSIBILITY		1.07	1.07		1.07					
CONDUCTIVITY, BTU/H.F.FT	0.06	0.09	0.06		0.06	0.10	0.12		0.37	
SURFACE TENSION, DYNE/CM	23.05								68.25	19.60
VAPOR FLOW AT P,T, ACFR		12.83	67.79		62.89	306.53				
	55.39						1.82			59.55
LIQUID FLOW AT P,T, USGPM	22.39						1.02			37.3.

JET FUEL STUDY JOB 5591 MTL BAL ARCA. 100 Zul, Sw DOE/AMOCO STUDY-05571
SECTION 300 - HYDROCRACKING
MATERIAL BALANCE
DOE/AMOCO STUDY-05571
SECTION 300 - HYDROCRACKING
MATERIAL BALANCE

****		
STREAM ID	309	310
STREAM NAME	HP/LT VAPOR	PURGE GASES
PHASE	VAPOR	VAPOR
COMPOSITION, LBMOLS/H H2O NH3	1.80	0.03
M2S H2 C1 C2 C3 C4 C5 150 F NBP 180 F NBP 212.5 F NBP 237.5 F NBP 242.5 F NBP 387.5 F NBP 387.5 F NBP 512.5 F NBP 510.5 F NBP	2076.38 153.52 15.38 16.00 18.53 1.72 1.81 0.88 0.34 0.20 0.11 0.14 0.03	31.15 2.30 0.23 0.24 0.28 0.03 0.03 0.01 0.01
TOTAL FLOW, LBMOL/H	2286.85 9368.80	34.31 140.50
TEMPERATURE, DEG.F PRESSURE, PSIG	120.00 1635.00	120.00 1635.00
MOLECULAR WEIGHT GRAVITY, DEG.API	4.10	4.10
VAPOR FLOW, MMSCFD LIQUID FLOW, BPSD	20.83	0.31
DENSITY AT P.T. LB/FT3 VISCOSITY AT P.T. CP VAPOR COMPRESSIBILITY COMDUCTIVITY, BTU/H.F.FT SURFACE TENSION, DYME/CM	1.03 0.01 1.05 0.06	1.03 0.01 1.05 0.06
VAPOR FLOW AT P.T. ACFN LIQUID FLOW AT P.T. USGPH	151.45	2.27
ENTHALPY, NOWSTU/H	-2.90	-0.04

JET FUEL STUDY

JUB 5571

MTL BAL & CEAS

ICU 200, 300

### 2.2 Naphtha Stream

### 2.2.1 Naphtha Distillation & Hydrotreating (Area 600)

Operating conditions for the naphtha distillation and hydrotreater were provided to Lummus by Amoco and these conditions are presented in Table 2.1. The basic processing steps selected were a distillation to produce a 160 F+ feed stock and a fixed bed hydrotreater. Referring to drawing D5571-601 the flow is as follows:

- The crude naphtha is charged to the Naphtha Distillation Column DA-601 via Surge Drum FA-601 and Feed Pump GA-601.
- . The column is reboiled with steam in EA-601 to produce a 160°F+ bottoms product.
- The 160<sup>0</sup>F- overheads are condensed in EA-602 and sent to fuel via GA-603.
- . The 160<sup>0</sup>F+ Distillation Column bottoms is charged to the HDT Surge Drum FA-603 via GA-602.
- 160<sup>0</sup>F+ naphtha is charged into the hydrotreater from Surge Tank FA-603 by Charge Pumps GA-604 through Feed/Effluent Exchanger EA-603.
- The charge oil is combined with feed hydrogen gas from Heater EA-604 prior to entering the feed/effluent exchanger. The preheated mixture is then charged to the Reactor DC-601.
- The Reactor DC-601 operates adjabatically with an average bed temperature of 450°F.
- . The effluent from DC-601 is cooled in EA-603 and flows through Exchangers EA-605 and EA-606. Process water is injected prior to EA-606 to convert the  $\rm H_2S$  and  $\rm NH_3$  in the gas to an aqueous  $\rm NH_4OH/NH_4HS$  solution.
- The cooled mixture then passes into the High Pressure/Low Temperature Separator FA-605 where hydrogen rich gas leaves overhead. A portion of this high pressure gas is purged to remove H<sub>2</sub>S and light gases from the loop and sent to the Rectisol Unit in the SNG plant to recover the hydrogen in the purge gas. The remaining gas is recirculated to Reactor DC-601.

- The water phase from Separator FA-606 goes to the PHOSAM Unit in the SNG plant to recover the  ${\rm H_2S}$  and  ${\rm NH_3}$ .
- The hydrocarbon phase from Separator FA-606 is preheated in Exchanger EA-605 and charged to the HDT Naphtha Stabilizer DA-602 which is reboiled by MP Steam to stabilize the naphtha.
- Offgas from the Naphtha Stabilizer is sent to the SNG plant for fuel.
  - The stabilized naphtha is cooled and sent to the Aromatics Recovery Unit (Area 700).

### Table 2.1 Naphtha Hydrotreater Operating Conditions

Naphtha Hydrotreater Conditions 160°F+ Naphtha Feed Stock Fixed Bed Reactor Type Number of Stages 1 LHSV Hr 450<sup>0</sup>F Average Reactor Temperature Reactor Pressure 500 psig H<sub>2</sub> Partial Pressure 2500 SCF/Bb1 H2 Recycle Rate Ni-Mo Catalyst Catalyst Replacement 2 years @ \$3/#

#### 2.2.2 Aromatics Recovery Unit (Area 700)

This unit is based on the Shell Sulfolane Process licensed by Universal Oil Products. Referring to Drawings D5571-701A and B the flow is as follows:

Stabilized Naphtha from the Naphtha Hydrotreater (Area 600) is charged to the Extraction Column DA-701 through Feed Surge Drum FA-701 by Feed Charge Pump GA-701. Lean solvent is charged to ne top of Column DA-701. As the feed flows through the column, aromatic components are selectively dissolved in the solvent. Raffinate with very low aromatics content is withdrawn from the top of DA-701.

Rich solvent leaves the bottom of the extractor. After heat exchange in Lean/Rich Solvent Exchanger EA-702, the rich solvent is charged to the top of DA-703, Stripper.

The raffinate stream from the Extractor Column DA-701 overheads is cooled in Raffinate Cooler EA-701 and then contacted with wash water in Water Wash Column DA-702. Water removes any dissolved solvent from the raffinate. Raffinate leaving DA-702 overhead is pumped to Gasoline Blending Stock Storage. The solvent rich water form DA-702 flows to DA-705, Water Stripper.

Solvent accumulates in the bottom of Water Stripper DA-705 and is pumped back to the Recovery Column by Water Stripper Bottoms Pump GA-710. The rich water is returned to the Recovery Column DA-704 as stripping steam generated via the Water Stripper Reboiler EA-709 by exchange with the hot circulating lean solvent.

A solvent regeneration system is included to guard against excessive solvent degradation. In normal operation a slipstream of solvent is routed to the Solvent Regenerator DA-706. Degraded solvent is periodically withdrawn from the bottom of DA-706.

In the stripper, non-aromatic hydrocarbons, which are more volatile, are stripped from the solvent, removed overhead, condensed and recycled to the Extractor Column DA-701 for reuse.

The stripper bottoms consists of aromatics in the solvent. This stream is pumped to the Recovery Column DA-704 by Stripper Bottoms Pump GA-704.

In the Recovery Column DA-704, the aromatics are stripped from the solvent. Lean solvent leaves the column bottom and is returned to Extraction Column DA-701 by GA-707 Lean Solvent Pump after heat exchange in Water Stripper Reboiler EA-709 and Lean/Rich Solvent Exchanger EA-702.

The aromatic product recovered overhead from the Recovery Column is fractionated to recover benzene, toluene and xylene product streams.

The recovery column overhead is pumped by Recovery Column Overhead Pump GA-709 to Clay Tower Surge Tank FB-703. From FB-703 the aromatic stream is pumped by Clay Tower Feed Pump GA-715 through Clay Tower Feed/Effluent Exchanger EA-712, Clay Tower Feed Heater EA-713 and then into Clay Towers DA-707A/B. In the Clay Tower, trace amounts of unsaturates and residual non-hydrocarbon impurities are removed.

After heat exchange in the Clay Tower Feed/Effluent Exchanger, the extract flows to Benzene Column DA-708. Benzene product is withdrawn from a tray near the top of the tower. After cooling in Benzene Product Cooler EA-715, benzene flows to Benzene Day Tank FB-704. Product from FB-704 is pumped to product storage by Benzene Product Pump GA-719.

#### LCI PROJECT 5571 TASK 4.0

Any water that accumulates in Benzene Column Reflux Drum FA-708 is pumped to Waste Treatment by Benzene Column Water Pump GA-718.

Benzene column bottoms are pumped by Benzene Column Bottoms Pump GA-716 to Toluene Column DA-709. The toluene product leaves overhead. Toluene is pumped from Toluene Column Reflux Drum FA-709 by Toluene Column Reflux Pump GA-721 through Toluene Product Cooler EA-720 to Toluene Day Tanks FB-706A/B. Toluene from FB-706A/B is pumped to storage by Toluene Product Pump GA-723.

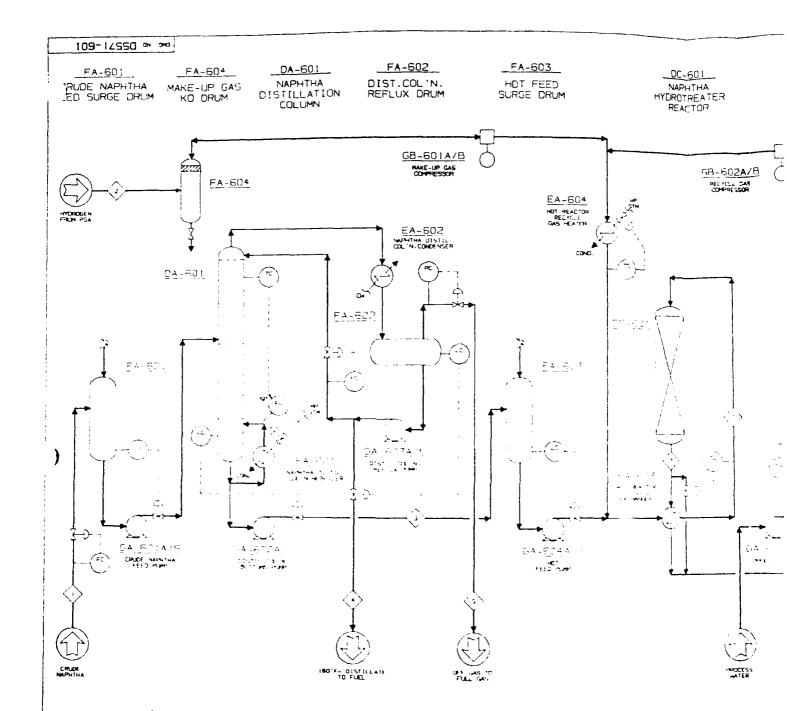
Xylene is taken as bottoms product from Toluene Column DA-709. Xylene is pumped by Toluene Column Bottoms Pump GA-720 through Xylene Product Cooler EA-718 to Xylene Day Tank FB-705. Xylene from FB-705 is pumped to storage by Xylene Product Pump GA-722.

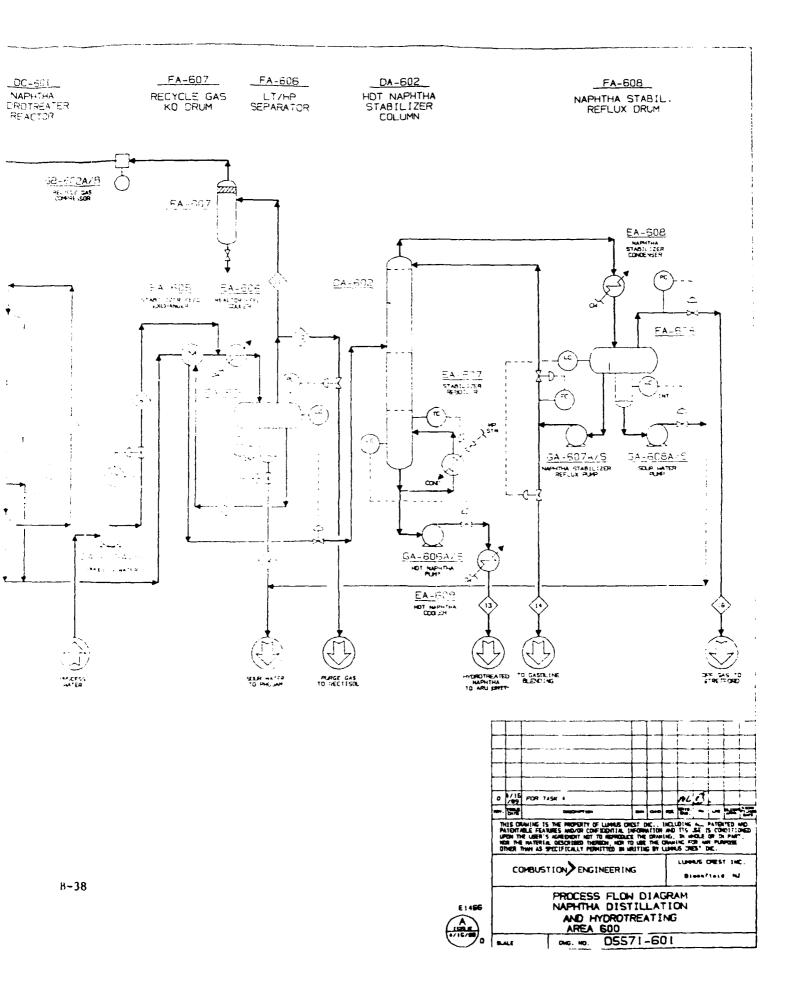
### LCI PROJECT 5571 TASK 4.0

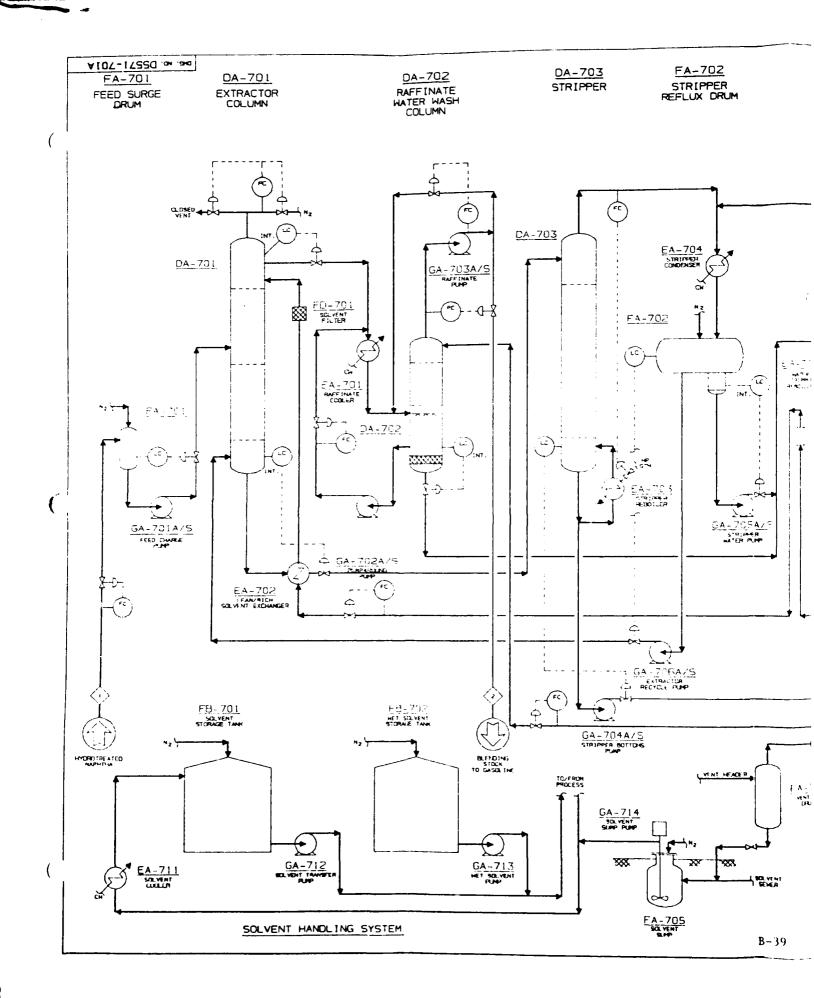
## 2.2 Naphtha Stream - cont'd

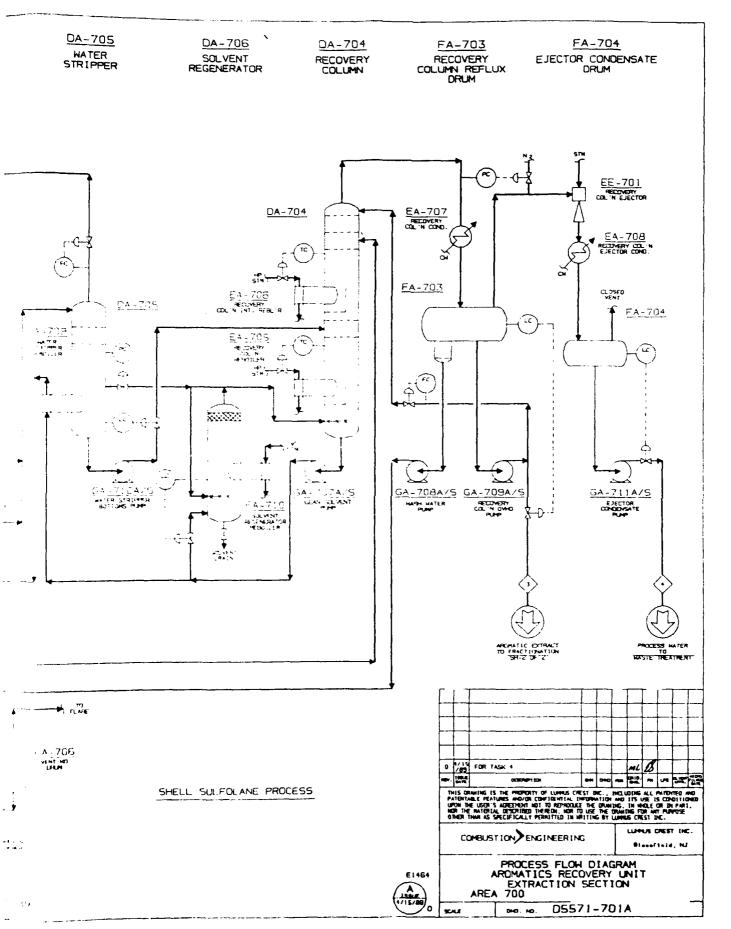
# 2.2.3 Process Flow Diagrams

Dwg.	<u>Title</u>
E5571-601	Naphtha Distillation and Hydrotreating
E5571-701A	Aromatics Recovery Unit Extraction Section
D5571-701B	Aromatics Recovery Unit Fractionation Section







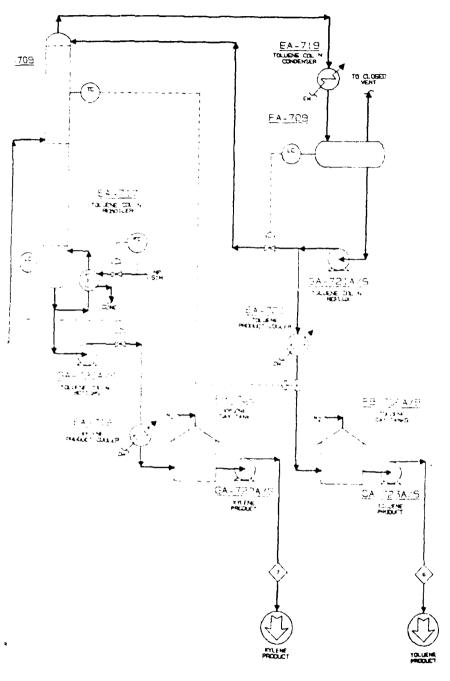


8104-14550 on on DA-708 FA-708 DA-707A/8 DA-709 CLAY TOWERS BENZENE COLUMN BENZENE COLUMN REFLUX DRUM TOLUENE COLUMN ( EA-716 BENZENE COL CONDENSER DA-708 CA-709 CHEOLD DI EA-715 DA-707A DA - 707B FA-708 EA-714 BENGTE COLIN. REPORTER EA-713 CLAY TOHER ۵ GA-7: 74/5 BENDAL DE H GA-718A/S SHALLS TE IN.  $\triangle$ EA -717 CLAY TOWER FEED FER EXCHANGER CA TOBA S BOTTON GA-77.4 FB-703 14.504 AN TANK E.A. PARTOC 31 GA-7:SA/B GA-7194/S CLAY TONER BENDINE PRODUCT (

B-40

DA-709 TOLUENE CULUMN

FA-709 TOLUENE COLUMN REFLUX DRUM



SHELL SULFOLANE PROCESS

0 1/15 FOR TASK 4

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COMBUSTION ENGINEERING

LUMES CHEST INC. Steenfteld, NJ

PROCESS FLOW DIAGRAM AROMATICS RECOVERY UNIT AROMATICS FRACTIONATION SECTION AREA 700

E1465

05571-7018 DHG. NO

B-4()

### LCI PROJECT 5571 TASK 4.0

# 2.2 Naphtha Stream

## 2.2.4 <u>Material Balances</u>

The following Material Balances were developed for Area 600.

AREA 600	!									1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																		,	ວັ	108 5571					•
ML DEC 31 1987	STAB SOUR H20 LIQUID	100.0000	0.0309	0.5570	18.0150		0.000	00.0	0.0000		0.000.0		0.5570	1	0.9977	18,0150	10.0635		0000	0.000	0000	0000*0		00.0	00.0	0.000	000000	0.0000	0.0000	0000	00.0	0.0000	0.0000	0.0000 0.0000	
	15 STAB OFFGAS VAPOR	100.0000	8.4432	313.3105	208.5772		313.3105	0.00	•	\$7-1079	0.3844		0.000		0.0000	•	0.0000		00000	000000	0000		9	310.9178	00.00	17 41 1	0.3877	0.9640	0.0102		00.0			0.0000	•
TM PROCESS SOLUTION	13 STAB PRD Lijuid	287.5287	73.8262	6135.1143	112.4480	1	0.000	00.00	0.0000	00000	0.000		6135.1143	77.076	0687.0	83.0008	45.5081	, ,	83.1004	10.0651	0.7399	967.9295	'	0.000	00.0	0000		0000 0	•		576.27			45.5080	, .
IMC. S STRIPPER	12 SOUR M20	120.0000	3 M	~ •	29.3215		00000	9 6	0.000	0.000	0.0000				•	$\sim$	61.2244		37.6836	10.2499	-5.3046	214.9373		0000	0.00	9,	? 5	00000	9		57.0830	0.8241	25.1254	39.6032	
VERSION 2.C1 SIMULATION SCIENCES INC. PROJECT GP JET FUELS PROBLEM NAPSTAB	STREAM LD STREAM MAME	TEMPERATURE, DEG F	PASSURE LB HOLS/NR	RATE LB /NR	ENTRALPY NR 410 / NR ENTRALPY 810 / LA ROLECULAR MEIGHT	*** VAPOR PHASE ***		ACT. RATE F13/SEC	STOORNE TR FISSON	3	ACT.DENS LB /FT3 COMPRESSIBILITY (2).	***   TOUTD PRASE ***	RATE LB /HR	-461 .8416 BBL /BAK	STO. LV MAIR BULLER CP. BIL /LB. F	MOLECULAR METENT	ACT.DENS LB /FT3 STD. API GRAVITY	*** ORY BASIS ***	RATE LB /HR	COP K	FLASH POINT, DEG F	CAIT. TEAP. F	*** VAPOR PHASE ***	RATE LB /HR	RE 513/ER	CP. BTU /LB F	MOLECULAR BELGHISSS	COMPRESSIBILITY (2).	VISCOSITY, CP	H4 010917	AAAA CAAA LE CAAAAAAAAAAAAAAAAAAAAAAAAAA	CP. STC //B f	NEIGHT	ACT-DENS LU /F13	TAR TAR TOLK

		11 LE GAS VAPOR	120.0000	7.0.000 4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4	691.6453	-0.1984	.286.8286 4.1071		691.6453	2,42	1,53	1.6091	1,01,4	1.0260	0.000	0.00	00.00	0000	0000	000000		0.0000	0.0000	0.000	0.000	0.000		7477 781	*/0***********************************	90.0	1.8233	4.0741	_	1.0261 JET FUEL STUBI
AREA 600		10 PURGE GAS RECYCLE VAPOR	,		21.7711	2,0062	•			0.01	0.05	1.609		1.0260	0.0000	00.00	0.00	0000	00000	0000		00000	02000	0.000	0.000	0000	•	(373	0.01	00.0	1.8233	4.0741	0.4532	1.0261
¥		COLD SEP LIG P	120.0000	700000	6446.4883	C.2584	78.3268		0000.3	00.0		0.0000	•	0000	6446.4883	- 941.70 -	21.83	96.61.04	50.8694	36,1255		6443.5264	78.4475	70.17.5	2178.87-	678.9440	•		00.0	00.0	000000	0000.3	0.0000	00000
5861 18 334 ML		B WASH WATER C LIQUID	190.0000	114 7717	5666.6672	0.1750	69.9971		0.0000	00.0	0.00	0.0000	00000	0.0000	5400.0002	172.41	7.15	77.70	44.6844	10.0035		0.000	0.0000	0.000	0000.0	0.000		0000	00.0	00.0	0000.0	0.000	0.000	0.000
		7 REACTOR FFFL L	475.0000	244 1791	7321,4014	2,5851	353.0820		7321,4014	0.03	2.41	0.6083	8269.72	0.9773	0.0000	00.0	00.0	0000.0	0000	0.000		0.000.0	0.0000	0000.0	0000.0	0000	•	7766 6000	06.0	0.10	0.6113	27.9733	2.2128	0.9768
TH PROCESS SOLUTION	OPERTIES SET	AEACTOR INLE F	425.0000	577.017	7324.1631	~	305.3162		7324.1631	00.0	2.53	0.6138	28.5822	0.9757	0.000	00.00	00.0	0000.0	0000	•		0.0000	0.0000	0000.0	0000.0	0.00.0	•		4364.0167	11.0	0.6139		2.2798	0.9756
INC.	REFINERY PROCESSOR PROPERT	<u>.</u>	70.0000	34646666	62.5395	-0.0066	-1030.5195	1	62.5395	0.15	0.28	3.4201	2.0174	1.0145	0.000	00.0	03.0	0000.0	0000-0	0.0000	ì	0.0000	0.0000	0.0000	0000*0	00000	•	***	02.5555	10.0	3.4201	2.0174	0.1187	1.0145
VENSION 2.01 SIMULATION SCIENCES I PROJECT GP JOT FUELS PROBLEM NAPHOT	REFINERY	STREAM NAME MAKE-UP GAS STREAM PRASE MAKE-UP GAS	RE, DEG	PATE LE BOLCER		ALPY NR 8	-	BAB VAPOR PHASE			STO.RATE MM FT3/DAY	CP. 6TU /LB f	N9138 W	COMPRESSIBILITY (2).	MATE LIBOID FRASE ***		STO. LV RATE BBL/HR			GRAV	TO SISY BASIS	RATE LB /HR	3			THE SECOND STATE		VAPOR PH	ACT.BATE LS /HR	£	16	CULAR BE	ACT. DENS Lb /FT3	181

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AATE LEGUIO PHASE AAA AAT. RATE GUL/DAY CP. BTU /LB F MOLECULAR WEIGHT... ACT. DENG LG /FT5 STD. API GRAVITY...

	~ 01	INC.	PROCESS		T.	And	
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	SUR S.	***************************************		6666.27	0000*0		
	RATE LO FOLS/HR	114.1968	35.9744	78.2163	NORMALLY		
	ALPY MR 010	-0.0349	0.0386	10.6911	2 ° °		
	OLECULAR BEIGH	76.5209	60.2673	83.9986			
ţ	TAPOR PHASE				1		
	RATE LG / TR	0000	0.0000	0000	00000		
	E	00.0	00.0	00.0	00.0		
	LB F	0.000	0.0000	0.000	0.0000		
-	9193	00000	0000-0	0000	0000*0	,	
	COMPRESSIBILITY (2).	0.0000	0000	0.0000	0.0000		
	SENT DELLE						
	ATE LO /HR	8737.9805	2168.0786	6570.0576	0.000		
₽.	5 88L/D	- 713.16	<b>208.3</b> 3	607.62-	00.0	1	
- /	CP. STU /LS F	07.00	0.5621	0.4886	0000		
/،	LECULAR WEIGHT	76.5209	60.2673	83.9986	0.000		
	LB /FT	52.3723	44.4841	46.2197	0.000		
i	STD. API GRAUITY	59.5750	90.0384	32.5314	0.000.0	:	
	DRY BASIS .						
	MATE LE /MR	8693.9824	2124.0786	6570.0576	0000.0		
		10.4363	11.4820	10.0981	0000		
	IN POINT, DEG F	-11.2329	-33.4546	19.7649	0.0000		
	CRIT. PRES. PSIA	- 530-7584 665-3411	449-4239 682-4471	565.6373 658.0043	0.000.0		
	*** YAPOR PHASE ***						
	/ 61	0.0000	0.000	0.000	0.000		
	ACT. RATE FT3/SEC	00.0	00.0	0.0	00.0	•	
	/LB F	00000	00000	0.0000	0.000		
	MOTECULAR METGHT	0000	0.0000	0000	0.0000		
	BILITY (2)	00000	0.0000	0.0000	00000		JET FUEL STUDY
	VISCOSITY, CP	0.0000	0.000	0000*0	0.000		163 5571
	AND LIGUID PHASE AND		3		0000		
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,	GRAVITY	5. 2. 4	71	\$100 °C	υτού <b>*</b> υ		

#### 2.3 Phenol Stream

The basic design data for processing the crude phenol stream were provided to LCI by the Dakota Gasification Co. (3).

The unit is divided into 3 sections:

- Area 800 Phenol Extraction
- Area 850 Cresylic Acid Extraction
- Area 900 Cresylic Acid Distillation

### 2.3.1 Phenol Extraction ( Area 800)

Referring to Process Flow Diagram D5571-800 A,B and C the flow is as follows:

- Crude phenol from the Great Plains Plant is charged to the flash column DA-801 form the surge drum FA-806 through pump GA-801. The recycle phenol stream from the Phenol Column DA-803 overhead is also charged to Column DA-801. The overhead from DA-801 is condensed by a 2 step condensation. Phenol is first condensed and refluxed back to the column and then a light oil/water mixture with phenol is condensed and decanted in Light Ends Drum FA-809. The phenol/light oil phase with dissolved water is pumped by GA-806 to the Light Ends Column DA-805. In the Flash Column phenol rich cresylic acid is separated from the tar residue. Phenol rich cresylic acid is side withdrawn and tar residue is pumped from the bottom of the column to the tar wash section.
- The Flash Column overhead product enters the Light Ends Column DA-805. The overhead light ends product is sent to SNG plant fuel. Water condensed in the overhead drum is combined with the aqueous phase from the Light Ends Drum and sent to sour water treatment. The bottoms from the Light Ends Column are pumped and mixed with the phenol rich cresylic acid stream.
- The side drawoff stream from DA-801 and the bottoms stream from DA-805 are sent to the Thin Film Evaporator ED-801. This combined stream contains the phenol, cresylic acid and neutral oil. This material is flashed over sulfuric acid to remove pyridine type substances. The vapor phase from ED-801 is dried in drier column DA-802, top vapor from the Dryer Column is condensed, hydrocarbon phase is refluxed back, aqueous phase is combined with the other water effluents. Bottoms from the Dryer Column is sent to the Phenol Column DA-803. Bottoms of ED-801 is mixed with the other tar streams.

- Cresylic acid from the Dryer Column, and the recycled phenol stream from cresylic acid distillation (Area 900) are charged to the Phenol Column DA-803 to produce an overhead stream which is returned to the Flash Column DA-801, a side draw stream of crude phenol and a bottoms stream which is pumped to the cresylic acid extraction (Section 850).
- . The crude phenol stream is stream stripped in a column to remove the impurities and produce a 99.8% pure phenol This section is a Lummus proprietary design.
- The combined tars are water washed in FD-8701/802, 1st and 2nd stage Water Wash Tanks, to remove acid materials and then routed to the Great Plains Fuel Pool.

#### 2.3.2 Cresylic Acid Extraction (Area 850)

The basic processing step used in this section is a dual solvent extraction to recover the cresylic acid. Referring to Process Flow Diagram D5571-850 the flow is as follows:

- . The dephenolized cresylic acid from DA-803 is fed to the cresylic acid extraction area where it is extracted with hexane and methanol/water in Extractor Column DA-851.
- . Hexane enters the Extractor Column at the bottom and preferentially absorbs the oil components. The hexane/oil mixture exits the top of DA-851.
  - A methanol/water solution enters the top of the extractor column and preferentially adsorbs the phenolic compounds. The methanol/water/phenolic mixture exits the bottom of DA-851.
- The oil components are stripped from the hexane in the Hexane Column DA-852. The hexane is recycled to Extractor Column DA-852. The oil is pumped by Hexane Column Bottoms Pump GA-852 through Neutral Oil Cooler EA-853 to the first stage Water Wash Tank FD-801.
- . Make-up Hexane is added as needed from Hexane Storage Tank FB-851 by GA-854 Hexane Make-Up Pump.

The phenolics are recovered from the methanol/water solution in Methanol Column DA-853. The methanol/water is condensed overhead and refluxed to the Methanol Column by Methanol Column Reflux Pump GA-856. Methanol Make-up Drum FA-854 receives the overhead product from the Methanol Column, the methanol/water make-up and the condensate from the Drying Column DA-854. The phenolics are pumped to Drying Column DA-808 by Methanol Column Bottoms Pump GA-855 through Methanol Column Bottoms Cooler EA-856.

Drying Column DA-856 is reboiled to remove water carry-over from the phenolic product. The dry Crude Cresylic Acid leaves the bottom of DA-856. Product is pumped to either Cresylic Acid Distillation (Area 900) or through the Crude Cresylic Acid Cooler EA-861 to the Cresylic Acid Day Tank, FB-852 by Drying Column Bottoms Pump GA-858.

Crude Cresylic Acid from Cresylic Acid Day Tank is pumped to storage by Crude Cresylic Acid Pump GA-859.

#### 2.3.3 Cresylic Acid Distillation (Area 900)

A two run block operation is used to separate the cresols and xylenols in the crude cresylic acid. In each block operation a series of distillation columns are used to progressively recover the higher boiling products.

#### 2.3.3.1 Block Operation #1

In this block operation, four distillation columns are used. Referring to Process Flow Diagram D5571-900A the flow is as follows:

Dry crude cresylic acid from Cresylic Acid Extraction (Area 850) is charged to Phenol/Ortho Column DA-901. The overhead liquid distillate from this column is fed to Phenol Column DA-902. DA-901 bottoms is pumped through Phenol/Ortho Column Feed-bottoms Interchanger EA-909 and is fed to M,P-cresol Column DA-903.

The overhead liquid distillate from the Phenol Column DA-902 is recycled to the Phenol Column DA-803 in the 800 Area. DA-902 bottoms is pumped through Phenol Column Bottoms Cooler EA-910 to O-Cresol Topping Feed Day Tank FB-901. The o-Cresol Topping Pump sends the o-Cresol to intermediate storage.

M,P-Cresol product is recovered overhead from M,P-Cresol Column DA-903. M,P-Cresol is pumped from M,P-Cresol Reflux Drum FA-903 through M,P-Cresol Product Cooler EA-912 to M,P-Cresol Product Cooler EA-912 to M,P-Cresol Day Tank FB-905. DA-903 bottoms is fed to Xylenol Topping Column DA-904.

The overhead liquid distillate from the Xylenol Topping Column DA-904 is recycled to M,P-Cresol Column DA-903. DA-904 bottoms is pumped through Xylenol Topping Bottoms Cooler EA-911 to Xylenol Intermediate Day Tank FB-902. From the day tank the xylenols are pumped to intermediate storage.

#### 2.3.3.2 Block Operation #2

In this block operation, three distillation columns are used. Referring to Process Flow Diagram D5571-900B the flow is as follows:

O-Cresol from O-Cresol Topping Intermediate Storage FB-908 is charged to O-Cresol Topping Column DA-901. The overhead liquid distillate from this column is recycled to Crude Cresylic Acid Intermediate Storage FB-853. DA-901 bottoms is fed to O-Cresol Column DA-902.

O-Cresol product is recovered overhead from O-Cresol Column DA-902. O-Cresol is pumped from O-Cresol Reflux Drum FA-902 by O-Cresol Reflux Pump GA-904 through O-Cresol Product Cooler EA-914 to O-Cresol Day Tank FB-903. GA-913 pumps the O-Cresol product from FB-903 to O-Cresol Intermediate Storage FB-910. DA-902 bottoms is pumped by O-Cresol Bottoms Pump GA-903 through O-Cresol Column Bottoms Cooler EA-910 to Slop Cut Intermediate Storage FB-911.

Xylenols from Xylenol Intermediate Storage FB-909 are charged to 2,4/2,5 Xylenol Column DA-904. 2,4/2,5 Xylenol product is recovered overhead from DA-904. 2,4/2,5 Xylenol is pumped from 2,4/2,5 Xylenol Reflux Drum FA-904 by 2,4/2,5 Xylenol Reflux Pump GA-916 through 2,4/2,5 Xylenol Product Cooler EA-916 to 2,4/2,5 Xylenol Day Tank FB-906. GA-910 pumps the 2,4/2,5 Xylenol product from FB-906 to 2,4/2,5 Xylenol Storage FB-914. DA-904 bottoms contains Mixed Xylenols and is pumped by 2,4/2,5 Xylenol Bottoms Pump GA-915 through 2,4/2,5 Xylenol Column Feed-Bottoms Interchanger EA-915 and 2,4/2,5 Xylenol Column Bottoms Cooler EA-911 to Mixed Xylenols Day Tank FB-907, GA-908 pumps the Mixed Xylenols from FB-907 to Mixed Xylenols Storage FB-914.

#### References

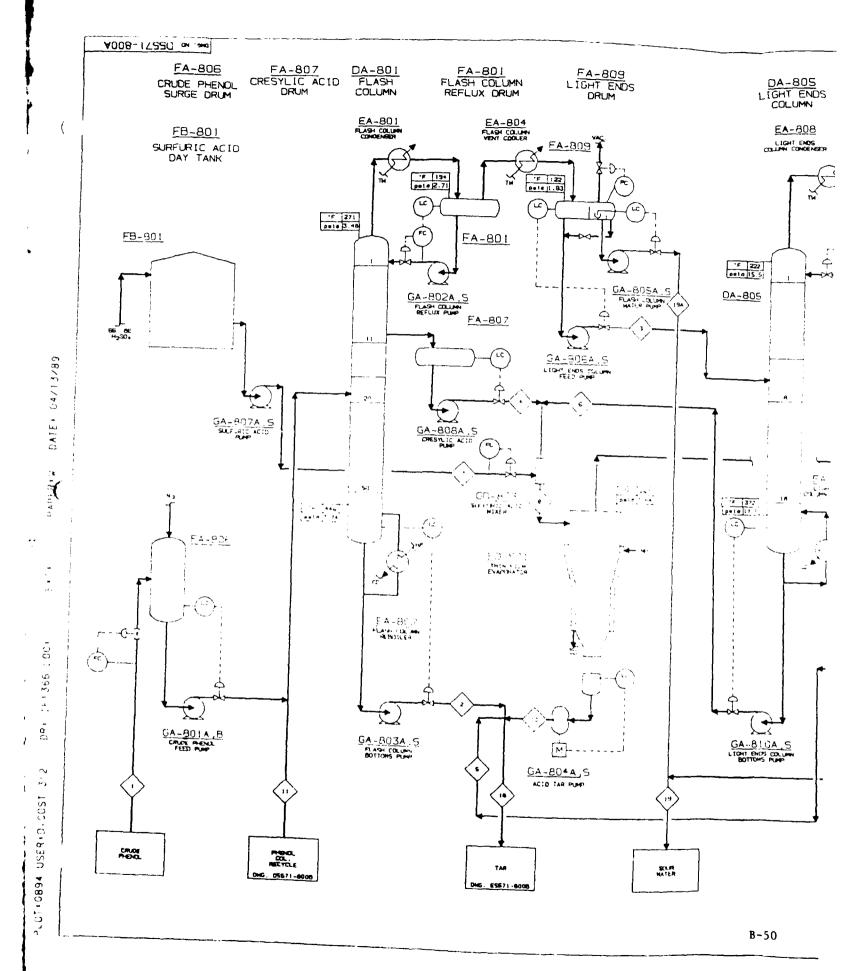
- 1) "Summary of Design Basis Data" dated January 16, 1989 (Sheets 1 to 10).
- 2) LCI letter G.L. Hamilton to Dr. M. W. Forlong dated January 30, 1989 "LC-Finer, Hydrotreater and Hydrotreater Basis of Design".
- 3) Minutes of Meeting "Crude Phenol Processing" dated August 25, 1988 and Dakota Gasification letter 9440-DHD-88-067.

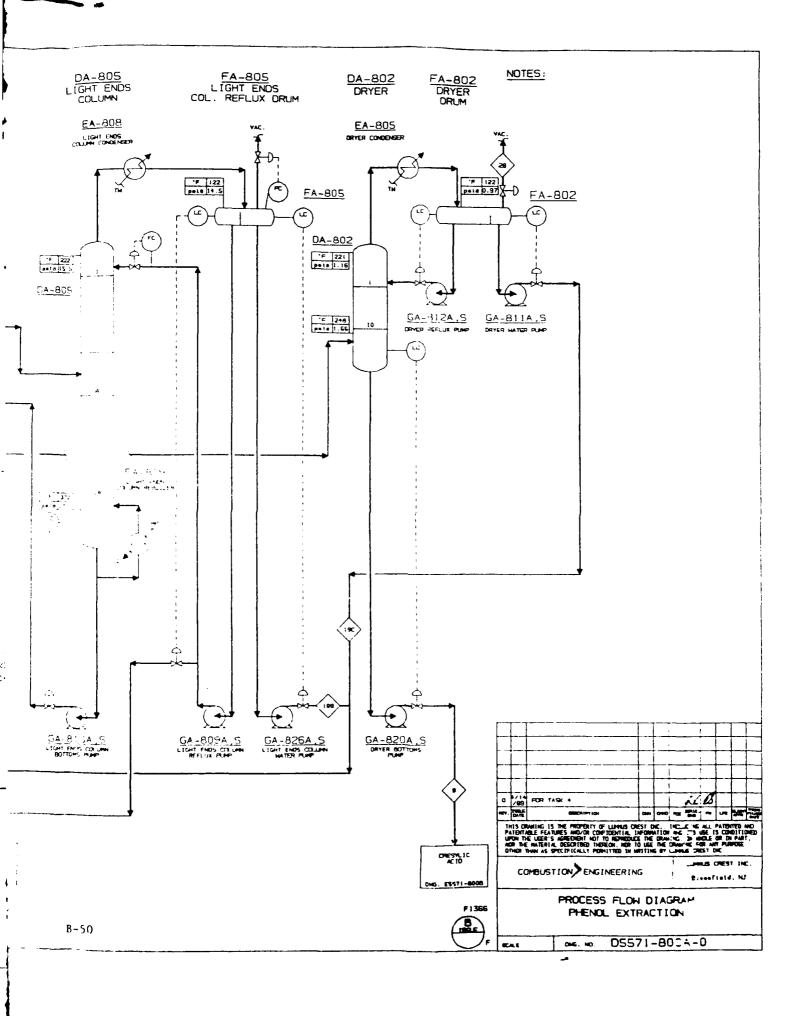
#### LCI PROJECT 5571 TASK 4.0

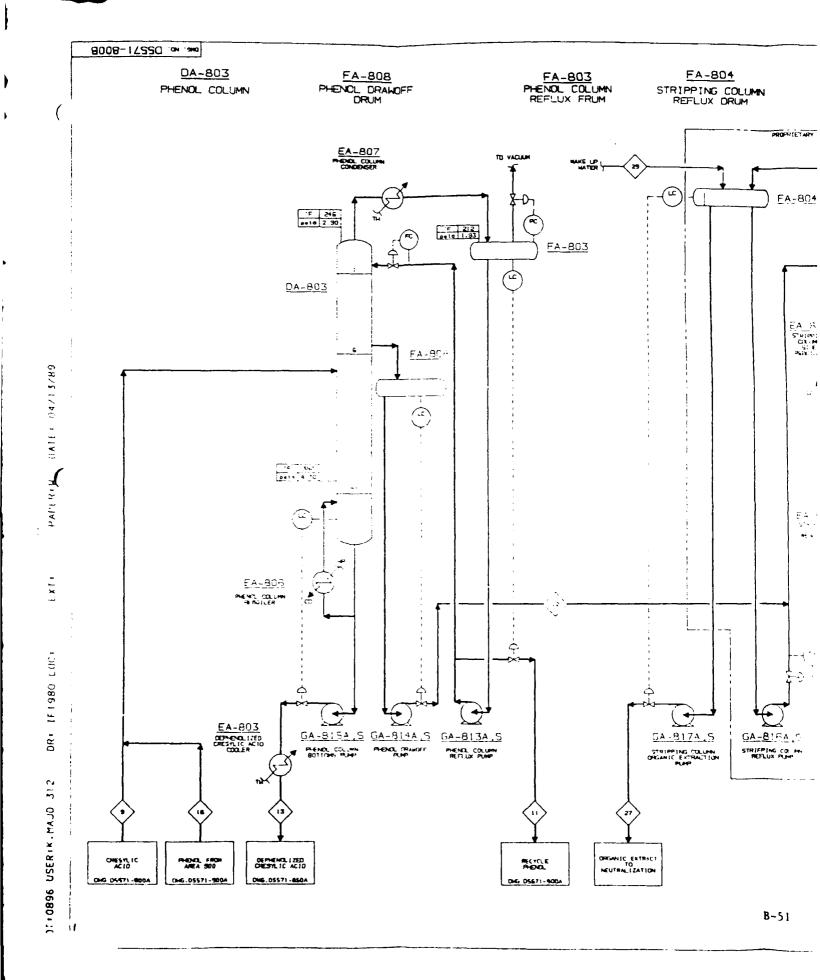
## 2.3 Phenol Stream - cont'd

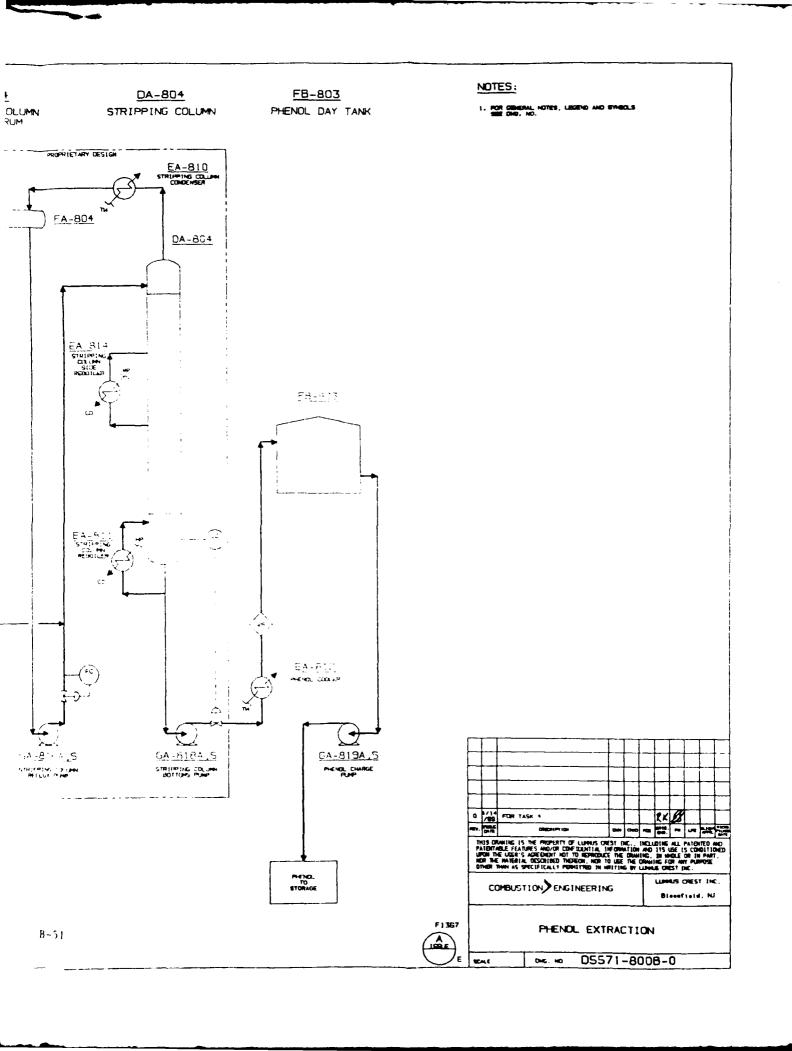
# 2.3.4 Process Flow Diagrams

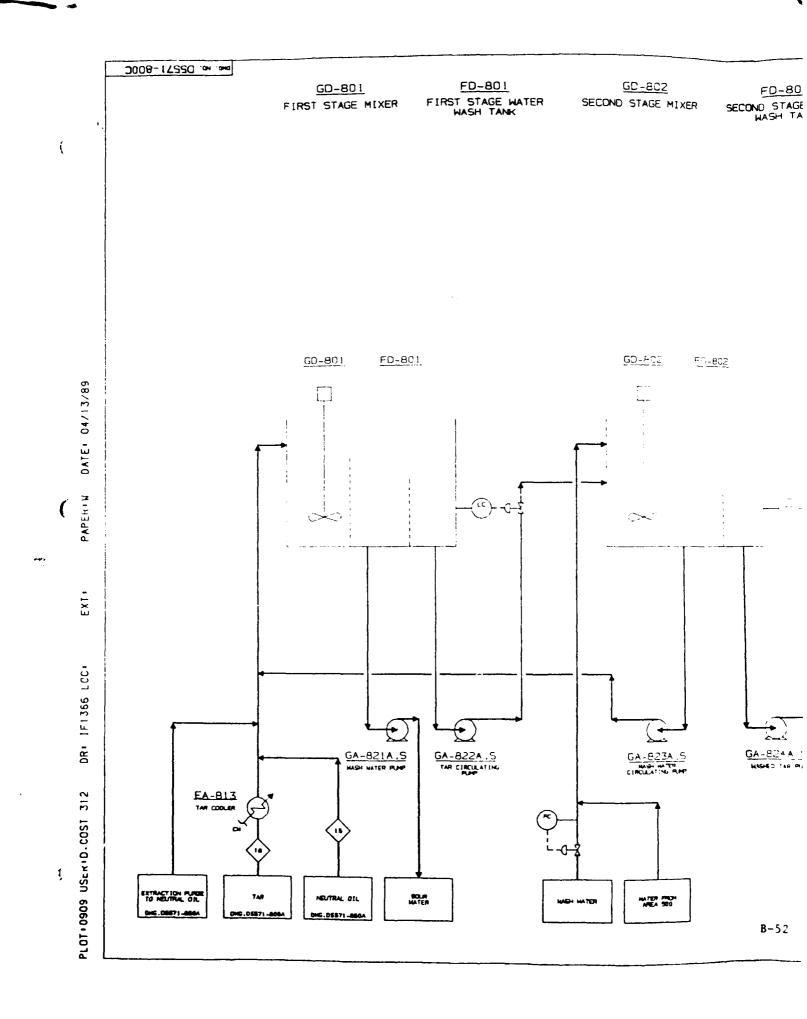
Dwg.	<u>Title</u>
E5571-800A E5571-800B E5571-800C E5571-850 E5571-900A	Phenol Extraction (Sheet 1 of 3) Phenol Extraction (Sheet 2 of 3) Phenol Extraction (Sheet 3 of 3) Cresylic Acid Extraction Crude Cresylic Distillation Block Operation #1
E5571-900B	Crude Cresylic Distillation Block Operation #2





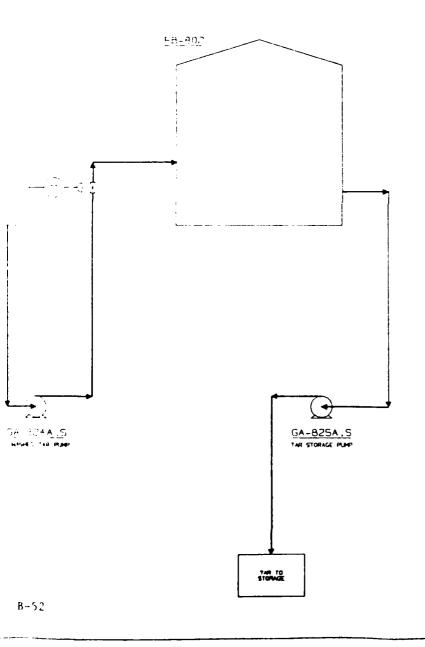


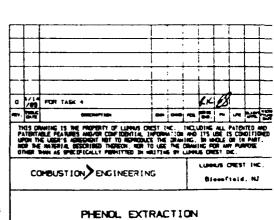




FD-802 ECOND STAGE WATER WASH TANK FB-802 TAR DAY TANK NOTES:

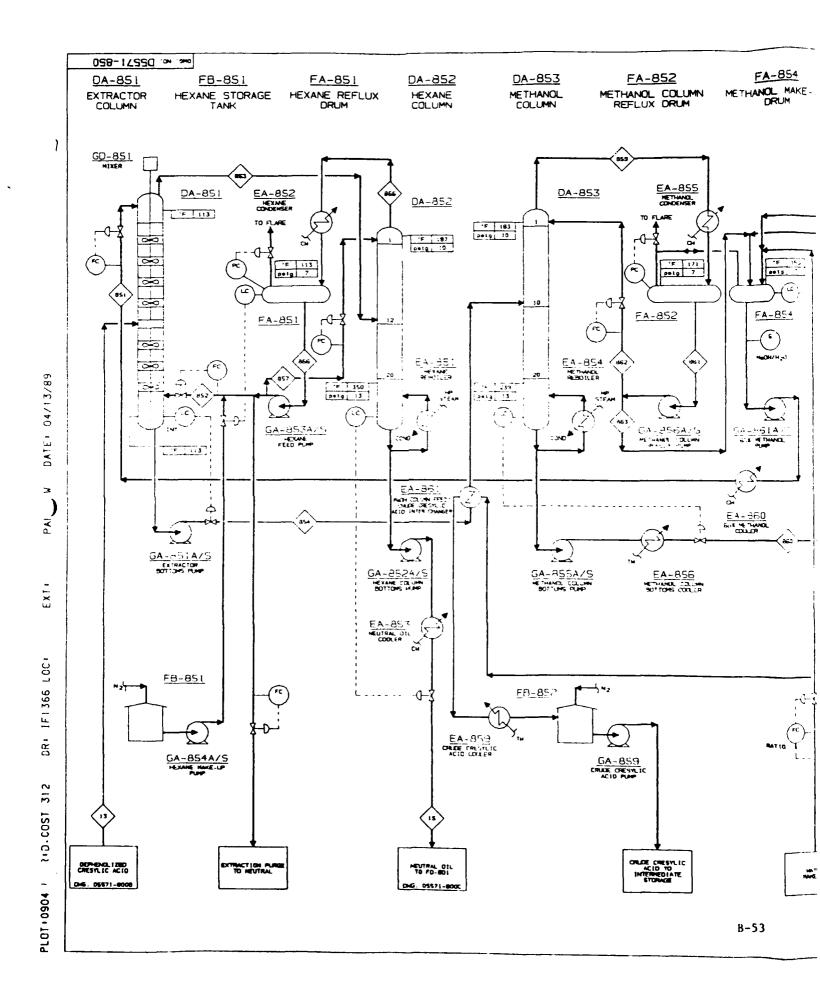
1. FOR CEMERAL NOTES, LEGEND AND SYMBOLS SEE ONG. NO.

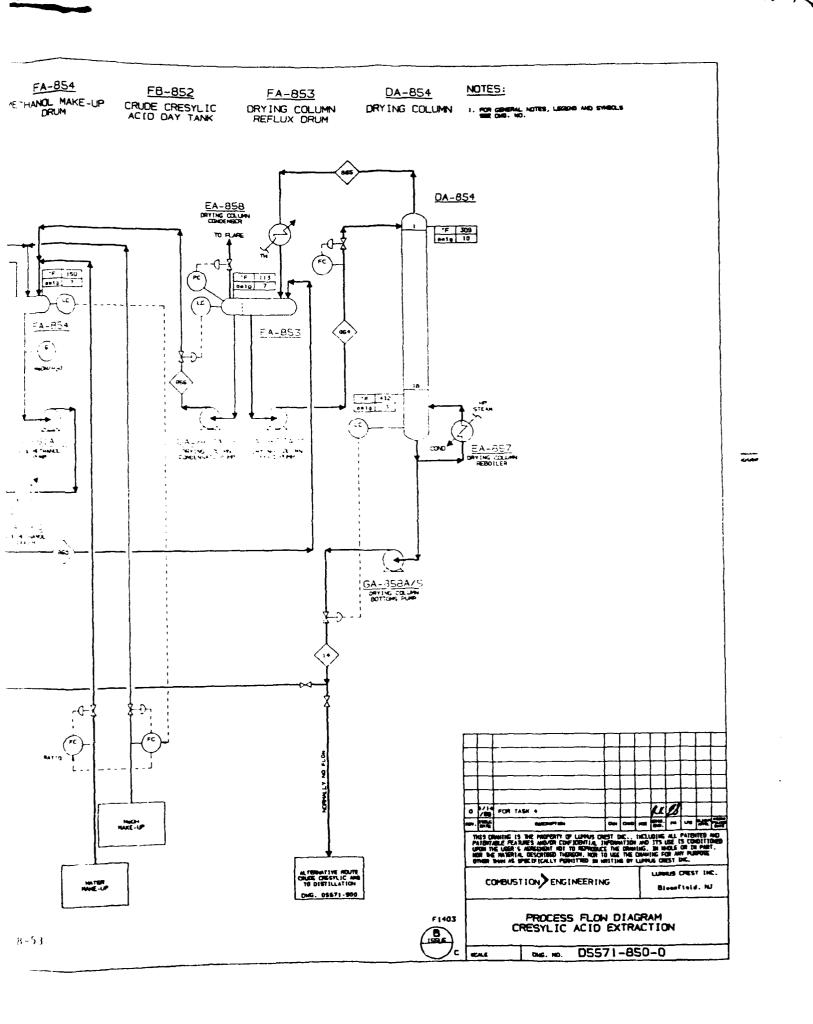


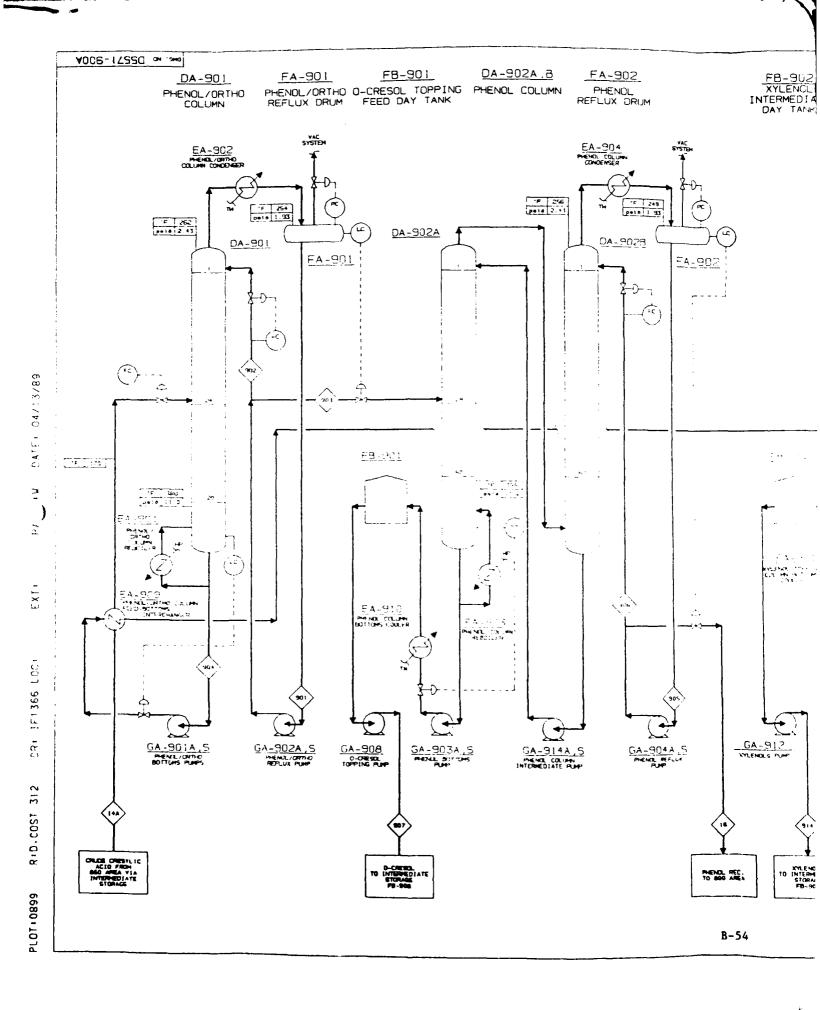


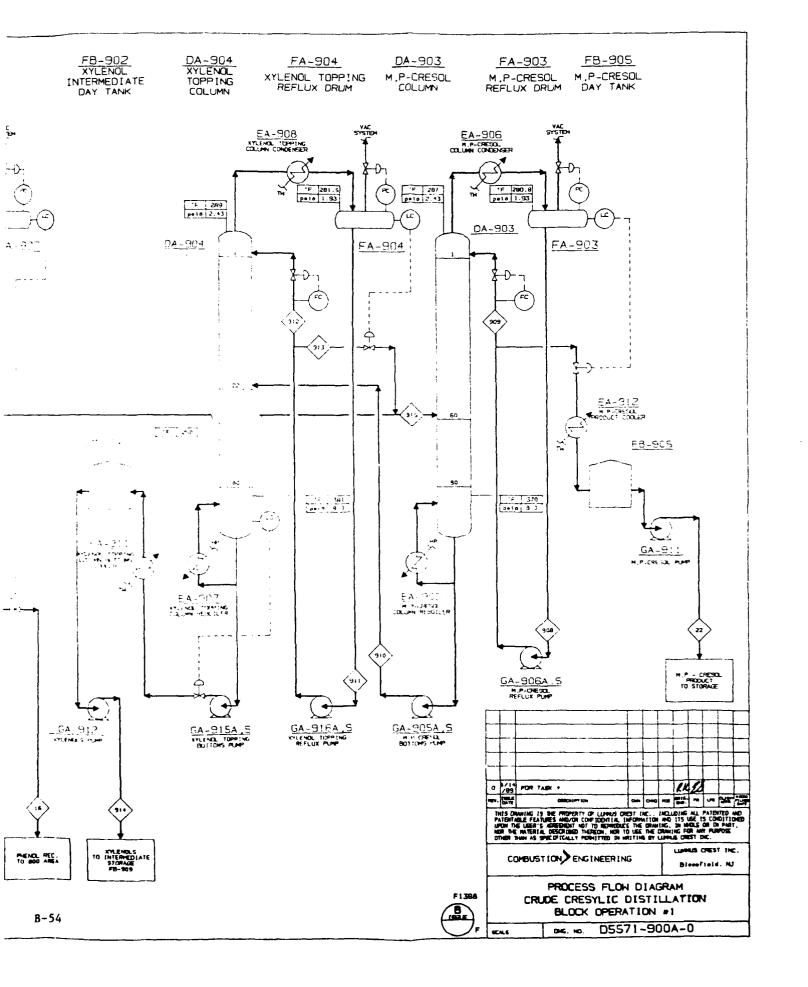
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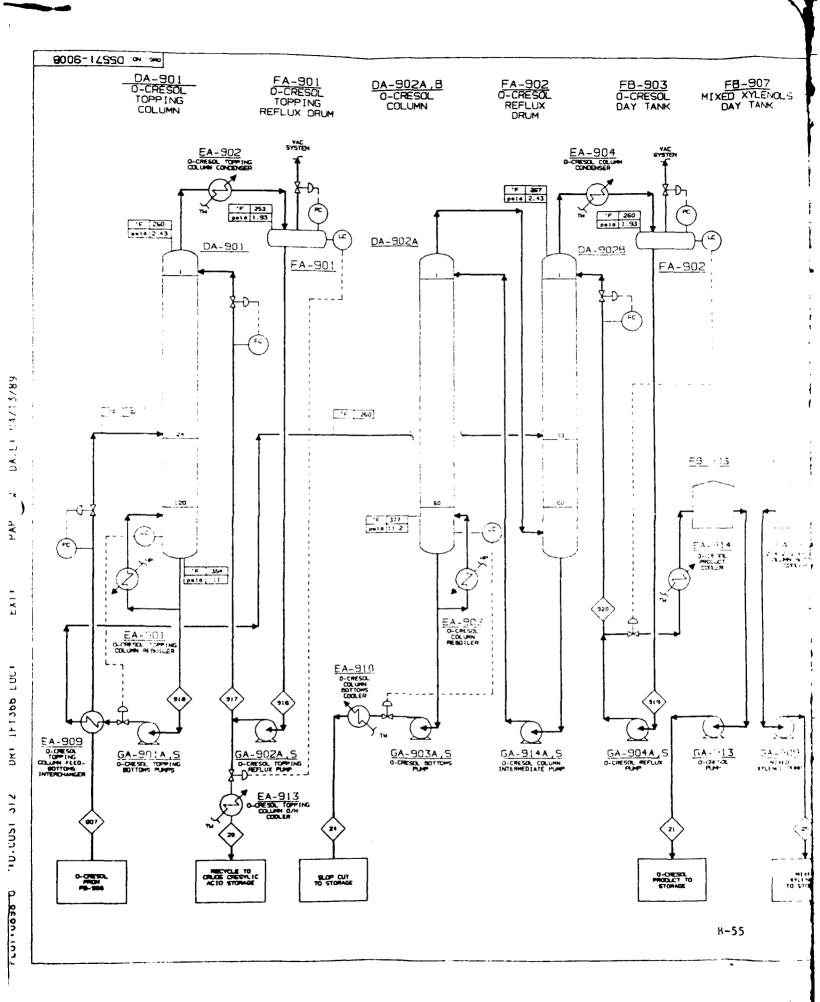
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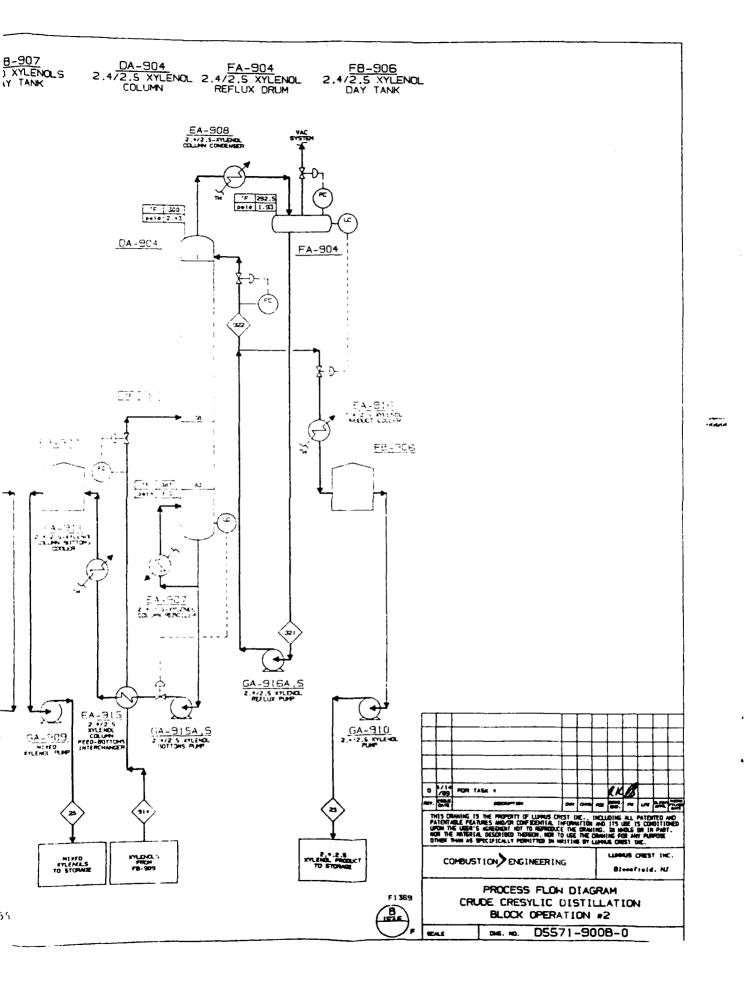












LCI PROJECT 5571 TASK 4.0

### 2.3 Phenol Stream - cont'd

### 2.3.5 <u>Material Balance</u>

 $$\operatorname{\textsc{The}}$$  following Material Balances were developed for Areas 800, 850 and 900.

STEM	1		3	4	ę	c	,	ē
LFS HE	CRUDE	BC110M	FEED	PHENOL	LIGHTEND	BOTTOM	H2504	FEEL
	PHENGL	DA801	DAS05	DAAW	PROD	DAB05	INJECTION	T.F.E
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FYRIDIN	141	141	0	Ç	0	0	0	Ç
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NEUTRAL DIL	411	¢	₹¢	373	Ú	39	Ú	412
O ERESOL	784	Ç.	74	712	(·	74	0	786
M CRESOL	1143	3	18	1122	0	18	Û	1141
P CRESCL	800	2	13	795	O	13	0	808
<b>GUATACOL</b>	103	0	2	101	0	2	O	103
O-ETHYLPHENOL	51	0	;	50	Ú	1	0	51
241YLENGL	141	4	<u>;</u>	13:	0	1	Ç	:37
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SPGF	1.60	1.35	:.(:	1.05	€.5	1.67	1.83	
BSE-	876	263	121	445	15	83	5	533

DET FUEL PROTECT
AMOUNDER GOVERN PLA MEGAST
COE NO SSTI
MATERIAL BALANCE - FOO SIN A

578M	:	10	11	12	13	14	15	lt.
LPS. HF	FEEC	T.F.E	PHENOL	PHENOL	EXTRACT	FEED	NEUTRAL	AREAS:
	DABIC	BCTTOM	PECYCLE	PRODUCT	FEED	AREA900	OIL	RECHELE
L <b>IG</b> HTS	4	0	4	(•	(1	Ú	0	ţ
PYRIDIN	0	6	6	٥	0	0	0	į
PHENOL	3992	210	264	3651	679	605	74	oi:
NEUTRAL DIL	391	21	1	4	386	0	386	Ç
O CRESOL	747	39	2	1	745	685	60	1
M CRESOL	1084	57	1	1	1081	995	87	(i
P CPESOL	767	<b>4</b> ()	1	Ċ	766	705	61	Ċ
BUAIACOL	98	5	C	C	98	90	8	(
G-ETHYLPHENGL	48	3	Ġ	Ċ	48	44	4	ġ
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ISIYLENCL	9:	5	(	Ċ	95	\$7	8	(,
2617LENOL	46	2	(-	(	4¢	43	3	
M-ETHILFHENGL	<b>t</b> c	ċ	•	(-	55	51	4	Ü
P-ETYLPHENGL	₹e	6	Ú	Ü	7 t	70	Ł	Ú
231+LENOL	27	3	(-	Ś	27	25	:	(
344YLENGL	34	4	Ú	ů	34	32	2	٠,
351 YLENGL	76	8	Ü	Ü	76	7ù	t	Ú
CATECHOL		:	₹		12	11	:	í
RESIDUES	Ĵ	0	×	ť.	(	0	Ġ.	· v
WATER	Û	(	· ·	0	į,	Ų	(	;
H2S04	ι	9	Ļ	•	(	Ĺ		
HEZANE	ΰ	ί	(•	Ç	Ü	c	ø	Ç.
METHANOL	, ,	U	·	v	Ç	Ú-		(·
SULFUR DIGNIDE	0	U	0	C	Ú	Ú	0	Ć.
TOTAL # HP	-881	515	272	3857	4355	3e3i	723	617
AF :	3.1	-7.9	-0.1	-i.7	6.0	4.4	14.3	-7.7
SFGF	1.05	1.15	1.08	1.08	1.03	1.04	0.97	1.08
B67	501	31	17	232	290	239	51	38

SET FUEL FROZERT AMUSCIASE - GREAT FLANS ON F 208 MO 05571 MATERIAL EALANCE . 800 ARCH

STRM LBS-HF	16 Tar	19 Sour Water	19A ADU. PHASE OF FA-809	178 AQU. PHASE OF FA-805	190 Sour Watr Fr Fa-Bo2
LIGHTS	244	0	O	0	0
PYRIDIN	141	0	0	ō	ò
PHENOL	212	42	42	ō	Č
NEUTRAL OIL	21	0	0	0	Ç
O CRESOL	39	0	O	Ö	ō
M CRESOL	60	0	0	0	Ö
P CRESOL	43	0	0	Ú	0
6UA I ACOL	5	Ú	0	Ú	0
O-ETHYLPHENOL	3	0	0	0	0
24xYLENOL	11	0	o	0	Ü
25XYLENOL	8	0	(.	0	Ú
26XYLENOL	5	Ú	6	(	G
M-ETHYLPHENOL	48	0	(ı	(	0
P-ETYLPHENOL	65	Ú	v	Č	(i
23XYLENOL	24	(,	6	0	()
34XYLENOL	30	Ú	C	ê	Ù
35XYLENGL	65	Ú	ŷ	0	Ċ
CATECHOL	1440	ċ	G	0	C
RESIDUES	2930	0	(i	O.	O
WATER	0	716	416	285	7
H2504	98	TRACE	(·	ő	TRACE
HEXANE	Ú	Ú	0	6	0
METHANOL	Û	(	(	Çi.	0
SULFUR DIOXIDE	G	Û	Ć	(	Ü
TOTAL #-HR	5473	75[	460	265	7
API	-1.0				
SPER	1.08	1.00	1.01	1.00	1.00
BSD	347	51	31	20	0

JET FUEL PEDJECT
ANOCC LINE - GREAT FLA WI TM F
JOB NO . OSSTI
MATERIAL BALANCE - FOO AREA

STRM LBS-HR	26 Phenol Product	27 ORGANIC STREAM	28 VENT GAS	29 MAKE UF WATER
	Ú	G	í	0
LIGHTS	Ú	Ŏ	Ú	Ŏ
PYRIDIN	3568	83	Č	Ŏ
PHENOL	3300	Ű	Ú	Ü
NEUTRAL OIL	1	Ú	()	Ċ
O CRESOL M CRESOL	í	(i	ò	í
P CRESUL	· i	Ğ	0	C
6UAIACOL	6		Ü	Ú
D-ETHYLPHENCL	Û	v.	ð	6
24xYLENGL	į	j		V <sup>1</sup>
25XYLENGL	Ú	(	(	(:
26XYLENGL	ė.	-		Û
H-ETHYLPHENOL	(1		(	Ú
P-ETYLPHENCL	v	į,	6	Ü
23XYLENIL		· ·	()	Û
34XYLENGL	Ú	Ú	Ú	Ù
35XYLENGL	(.	Ü	Ú	ţ.
CATECHOL	Ú	v	ι	5
RESIDUES	0	(	Ú	û
WATER	ē	1	4	:
H2Sv4	·	j	i	IJ
HEIANE	· Ú		ċ	Ŀ
METHANOL	- ਹ	ÿ	(,	V
SULFUF DIGAIDE	ŷ	Ć	14	÷
TOTAL #+HF	3574	84	18	i
AFI	-0.7	-0.6		
SP6R	1.08	1.68		1.00
BSD	22 <b>6</b>	5		

CET FUEL PROJECT

Andic 100E. GREAT TLANGE

JOE NO 05571

MATTERIAL BALANCE BONDS

E77	EAR WO.	27 CFICE FRENCE	ESI METHANIL TO EXTRATE	852 REPARE TO EMPRIR	HE: ALE	ESA MERMANII FR EXTRATA (	VAFOE	CONE. FF	REFLEX TO	15 Neutral Bil
\$ 45	ENI.	<b>6</b> 74.0	18.1		74.5	522.5				74.1
	144.0	36:	٧		391.5		25.3	25.3	19.E	
	18500	745.	4,5		D. V.	ء ۽ ء				tů.
	FEST	1981.	1.5		€*•.	10.2.5				٤٠.
<b>:</b>	SEELL.	lei.			oi.(	717				61.1
÷		÷ć			6.0	90.7				€.0
٤ - ٠	F- F-	43.			.4.(	44.5				4.0
::	. i				11					11
::;	1.51.	95	٠		5.0					€.9
76	V12711	41,	1.2		•					•
		t : .	5 + 2	•	2.0					4.
	E n. in	z.,			:					·
	· · <u>- </u>				4					1.0
	: <u></u>	74			4.					•••
353	1116.1	76	5.00		٠					s.(
	TEC+12		:		. • •					
RE:	::::E		·		:					
	12:				. • 5					
	sedE		5.45		E45			18874.1	1 -1:	
ų.	FreNIL		25 4.:			75/4.5				
19	; * -	L'	5541	édber:	4174.5	5133.1	38899.9	32829.5	30443.4	721.3
ŢΕ	ħΣ., i⁵				113					1 11
	623 . <b>.</b>	\$44.		74,0		55.0		35.7		
	4	č. i		20.50	25.17	20.50		177.16	95.00	1.5
ξ.	e. <b>6</b> sv c	1.67								(,;**
, ai		0.0								14.7
63	12	250								51

JET FUEL PROJECT

Andre LOG-CREAT PLANT CMIF (\*)

JAB NO. DESTI

HATTERIAL BALANCE - 950 ANIA

	STAZAK NÚ.	BER MARIE FR MEGH COL	650 MEGH CSL BOTTOMS	Bol CONS. FR REGH COL	862 REFLE: TO MEGH COL	Bo3 COND. TO MEGH PARE UF DRUM	864 FEED TO DEVING COL		BOG DECANT: WATE TO MEDN MAKE UP DRUM		
	FHENG.		627.6				1005.5	404.9	18.9	605.0	
	NE THAL O								6.0	ė.ė	
	G OFESCL		ودِن د				911.7	226.I		685.0	
	#-CRESCL		11.4.5				1162.8	167.5		645	
	F LFESIL		7: 2				813.9	112.5		165.0	
	61414001		90.7				105.2	15.2		<b>5</b> 0	
	3-81H LFF		44.2				51.4	7.4		44.0	
	141 .E452		110.3				132.2	13.1		115.0	
	150 LÉNDL		5:12				96.7			ē <sup>-</sup> .}	
	Zennekvil		47.1				47.8			47. :	
	M-Einlife		51.1				55.0			<b></b>	
	P-EIH/LPH		70.2				75.4				
	27: LENCE		25				26.5			.t. 32.4	
	34a kuéndu		3				34.5			Sult Svet	
	354 YLENCL		7				75.4			11.	
	CATECHOL		13.5				11.4	0.4		44.	
	REBIDUÉE		((								
	M4 TEF	F7E,4	1547,9	278.4	:	_	675.1				
_	HERRAE	* • •	7.1	<b>6.</b> (							
(	nethall	HIII.s	<b>4.</b> v	F287.a	8747 V	. 3570.6	5.2	8.2	4.0		
	T01+2 # #	1/251/4	Mil	1c2e1.3	e215.	3945,5	500.1	1e-1.	1594.0	1611.4	7:::
	TEMF of	151	415	17:			113			401	117
	DENSIT: (#) IF BPM		62.9 10.35	47, <i>a</i> 27,21					61.7 3.22	57.1 8.53	::. <u>:</u>
	S. E. €r. c. AF; £50									1.04 4.4 235	

ኝ.

JET FUEL PROJECT
ROOCLEDE GREET FLAIRS GREE, FROZ
JOB NO 186571
HATERIAL BALANIE - 850 APRA

STREAM NO.	14 CRUDE CRESYLIC ACID	14A FEED TO PHENOL-ORTHO COLUMN	901 COND. FROM PHENOL-ORTHO REFLUX DRUM	902 REFLUX TO PHENOL-ORTHO COLUMN	903 FEED TO PHENOL COL.	904 PHENOL-ORTHO COL. BTMS.	905 COND. FROM PHENOL COL. REFLUX DRUM	906 REFLUX TC PHENOL COL.
PHENOL	605.0	710.0	6106.0	5396.0	710.0	0.0	6622.0	<b>602</b> 0.0
NEUTRAL O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O CRESOL	685.0	775.0	6665.0	5890.0	775.0	0.0	11.0	10.0
M · CRESOL	995.0	<b>995</b> .0	25.8	22.8	3.0	992.0	0.0	0.0
P CRESOL	<b>705</b> .0	705.0	17.2	15.2	2.0	703.0	0.0	0.0
GUATACOL	90.0	90.0	0.0	0.0	0.0	90.0	0.0	0.0
O-ETHYLPH	44.0	44.0	0.0	0.0	0.0	44.0	0.0	0.0
24XYLENOL	119.0	119.0	0.0	0.0	0.0	119.0	0.0	0.0
25XYLENOL	87.0	<b>8</b> 7.0	0.0	0.0	0.0	87.0	0.0	0.0
26XYLENOL	43.0	43.0	34.4	30.4	4.0	39.0	0.0	0.0
M-ETHYLPH	51.0	51.0	8.6	7.6	1.0	50.0	0.0	0.0
P-ETHYLPH	70.0	70.0	0.0	0.0	0.0	70.0	0.0	0.0
23XYLENOL	25.0	25.0	0.0	0.0	0.0	25.0	0.0	0.0
34XYLENOL	32.0	32.0	0.0	0.0	0.0	32.0	0.0	0.0
35XYLENOL	70.0	70.0	0.0	0.0	0.0	70.0	0.0	0.0
CATECHOL	11.0	11.0	0.0	0.0	0.0	11.0	0.0	0.0
RESIDUES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL #/H	<b>363</b> 2.0	3827.0	12857.0	11362.0	1495.0	2332.0	.6633.0	6030.0
TEMP., of	77.0	77.0	253.4	253.4	253.4	379.6	249.0	249.0
DENSITY,#/CF	63.5	63.5	60.4	60.4	60.4	53.9	61.4	61.4
GPM	7.1	7.5	26.5	23.5	3.1	5.4	13.5	12.2
s.G. <b>260</b> /60	1.04	1.04	1.06	1.06	1.06	1.02	1.08	1.08
AP1	4.4	4.4	2.0	2.0	2.0	7.2	-0.7	-0.7
BSD	239.3	252.1	831.1	734.4	96.6	156.6	420.8	382.6

TET FUEL PROJECT

AMORIO 100E - UREAT FLAVOUS (ALVE TO L.

JOS ON 2021

MATER AL BALANCE - 900 FLEA

STREAM NO.	16 PHENOL RECYCLE TO 800 AREA	907 FEED TO O-CRESOL TOPPING COL.	915 FEED TO M,P-CRESOL COLUMN	908 COMD. FROM M,P-CRESOL REFLUX DRUM	909 REFLUX TO M,P-CRESOL COLUMN	22 M,P-CRESOL PRODUCT	910 FEED TO XYLENOL TOPP. COL.	911 COND. FROM XYLENOL TOPP. REFLUX DRUM
PHENOL	602.0	108.0	0.0	0.0	0.0	0.0	0.0	0.0
NEUTRAL O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O CRESOL	1.0	774.0	0.0	0.0	0.0	0.0	0.0	0.0
M-CRESOL	0.0	3.0	1180.7	7432.5	6441.5	<b>99</b> 1.0	189.7	3207.9
P CRESOL	0.0	2.0	836.7	5265.0	4563.0	702.0	134.7	2272.9
GUATACOL	0.0	0.0	107.0	675.0	585.0	90.0	17.0	289.0
O-ETHYLPH	0.0	0.0	52.4	330.0	286.0	44.0	8.4	142.8
24XYLENOL	0.0	0.0	137.5	37.5	32.5	5.0	132.5	314.5
25XYLENOL	0.0	0.0	100.5	30.0	26.0	4.0	96.5	229.5
26XYLENOL	0.0	4.0	41.4	292.5	253.5	39.0	2.4	40.8
M-ETHYLPH	0.0	1.0	50.0	0.0	0.0	0.0	50.0	0.0
P-ETHYLPH	0.0	0.0	70.0	0.0	0.0	0.0	70.0	0.0
23XYLENOL	0.0	0.0	25.0	0.0	0.0	0.0	25.0	0.0
34XYLENOL	0.0	0.0	32.0	0.0	0.0	0.0	32.0	0.0
35XYLENOL	0.0	0.0	70.0	0.0	0.0	0.0	70.0	0.0
CATECHOL	0.0	0.0	11.0	0.0	0.0	0.0	11.0	0.0
RESIDUES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL #/H	603.0	892.0	2714.2	14062.5	12187.5	1875.0	839.2	6497.4
TEMP., oF	249.0	113.0	253.0	281.0	281.0	113.0	369.0	281.0
DENSITY,#/CF	61.4	64.4	58.1	58.0	58.0	63.3	53.2	57.8
GPM	1.2	1.7	5.8	30.2	26.2	3.7	2.0	14.0
s.G. <b>060</b> /60	1.08	1,04	1.02	1.04	1.04	1.04	0.99	1.03
API	-0.7	5.1	7.2	5.1	5.1	5.1	11.4	5.9
BSD	38.3	58.8	182.3	926.5	802.9	123.5	58.1	432.2

JET FUEL PROJECT

ANDICA TORE - UNITED TORING (AC # .

John NO OSS 71

MATERIAL GALANCE - 100 ARCA

STREAM NO.	912 REFLUX TO	913 RECYCLE TO	914 FEED TO	916 COND. FROM	917 REFLUX TO RE	20 C. TO CRUDE	918 FEED TO	919 COND. FROM
	XYLENOL TOPP	M,P-CRESOL	XYLENOL COL.	O-CRESOL	O.CRESOL	CRES ACID	O-CRESOL COL	O-CRESOL COL
	COLUMN	COLUMN		TOPP. COL.	TOPP. COL.	STORAGE		
PHENOL	0.0	0.0	0.0	1575.0	1470.0	105.0	3.0	33.0
NEUTRAL O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O CRESOL	0.0	0.0	0.0	1350.0	1260.0	90.0	684.0	7513.0
M-CRESOL	3019.2	188.7	1.0	0.0	0.0	0.0	3.0	0.0
P CRESOL	2139.2	133.7	1.0	0.0	0.0	0.0	2.0	0.0
GUA I ACOL	272.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0
O-ETHYLPH	134.4	8.4	0.0	0.0	0.0	0.0	0.0	0.0
24XYLENOL	<b>296</b> .0	18.5	114.0	0.0	0.0	0.0	0.0	0.0
25XYLENOL	216.0	13.5	83.0	0.0	0.0	0.0	0.0	0.0
26XYLENOL	38.4	2.4	0.0	0.0	0.0	0.0	4.0	11.0
M-ETHYLPH	0.0	0.0	50.0	0.0	0.0	0.0	1.0	<b>0</b> .0
P-ETHYLPH	0.0	0.0	70.0	0.0	0.0	0.0	0.0	0.0
23XYLENOL	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0
34XYLENOL	0.0	0.0	32.0	0.0	0.0	0.0	0.0	<b>0</b> .0
35XYLENOL	0.0	0.0	70.0	0.0	0.0	0.0	0.0	0.0
CATECHOL	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0
RESIDUES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL #/H	6115.2	382.2	457.0	2925.0	2730.0	195.0	697.0	7557.0
TEMP., OF	281.0	281.0	113.0	253.0	253.0	113.0	354.0	260.4
DENSITY,#/CF	57.8	57.8	59.5	60.5	60.5	64.8	56.1	59.3
GPM	13.2	0.8	1.0	6.0	5.6	0.4	1.5	15.9
s.G. <b>a60/6</b> 0	1.03	1.03	0.97	1.07	1.07	1.07	1.05	1.05
API	5.9	5.9	14.4	0.7	0.7	0.7	3.3	3.4
850	406.8	25.4	32.3	187.3	174.8	12.5	45.5	493.1

DEF FUEL PROJECT

AMOUNT POSE - GREAT PLACES CALE

JOS NO 05571

RATERIAL BRANCE - GOORCE

STREAM NO.	920	21	24	921	922	23	25
	REFLUX TO	O-CRESOL	SLOP CUT	COND FROM	REFLUX TO	2,4/2,5·XYL	MIXED
	O-CRESOL COL	PRODUCT		XYLENOL	XAFENOF COF	PRODUCT	XYLENOLS
				REFLUX DRUM			
PHENOL	30.0	3.0	0.0	0.0	0.0	0.0	0.0
NEUTRAL O	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O CRESOL	6830.0	683.0	1.0	0.0	0.0	0.0	0.0
M-CRESOL	0.0	0.0	3.0	16.0	15.0	1.0	0.0
P CRESOL	0.0	0.0	2.0	16.0	15.0	1.0	0.0
GUATACOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O-ETHYLPH	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24XYLENOL	0.0	0.0	0.0	1680.0	1575.0	105.0	9.0
25XYLENOL	0.0	0.0	0.0	1232.0	1155.0	77.0	6.0
26XYLENOL	10.0	1.0	3.0	0.0	0.0	0.0	0.0
M-ETHYLPH	0.0	0.0	1.0	16.0	15.0	1.0	49.0
P-ETHYLPH	0.0	0.0	0.0	0.0	0.0	0.0	70.0
23XYLENOL	0.0	0.0	0.0	0.0	0.0	0.0	25.0
34XYLENOL	0.0	0.0	0.0	0.0	0.0	0.0	32.0
35XYLENOL	0.0	0.0	0.0	0.0	0.0	0.0	70.0
CATECHOL	0.0	0.0	0.0	0.0	0.0	0.0	11.0
RESIDUES	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PEXANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ETHANOL	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL #/H	<b>687</b> 0.0	687.0	10.0	2960.0	2775.0	185.0	272.0
TEMP., of	260.4	113.0	113.0	292.5	292.5	113.0	113.0
DENSITY,#/CF	59.3	63.9	62.2	54.6	54.6	59.3	59.2
GPM	14.4	1.3	0.02	6.8	6.3	0.4	0.6
s.G. <del>26</del> 0/60	1.05	1.05	1.02	0.97	0.97	0.97	1.03
API	3.4	3.4	7.9	15.1	15.1	15.1	5.7
BSD	448.3	44.8	0.7	209.1	196.0	13.1	18.1

THE FUEL PROJECT
AMOUN TONE GREAT PLANT CALL
TON NO. OSSTI
MATERIAL MALANCE - 400 PALE

APPENDIX C

LCI Report on "Profitable JP-8" Design:

<u>Capital Costs</u>

## 3.1 Equipment Lists

AREA 100	-	HYDROTREATER
TAG NO.	-	DESCRIPTION
BA-101 BA-102		Preflash Heater Feed Heater
DA-101 DA-102 DA-103		Preflash Tower Atmospheric Tower Vacumm Tower
DC-101 DC-102 DC-103		Hydrotreater Reactor Hydrotreater Reactor Hydrotreater Reactor
EA-101 EA-102 EA-103 EA-104 EA-105 EA-106 EA-107 EA-108		HVGO Condenser/BFW Exchanger LVGO Condenser Hot H.P. Separator Vapor/Steam Generator Hot L.P. Separator Vapor/BFW Exchanger Atmospheric Tower Reboiler Atmospheric Tower Overhead Condenser Fuel Gas Cooler Recycle Compressor Circulation Cooler
EC-101 EC-102		Recycle Gas Cooler Preflash Tower Overhead Condenser
FA-101 FA-102 FA-103 FA-104 FA-105 FA-106 FA-107 FA-108 FA-109 FA-110 FA-111 FA-111		Feed Surge Drum Hot H.P. Separator Hot L.P. Separator Interm. L.P. Separator Cold L.P. Separator HVGO Accumulator LVGO Accumulator Vacuum Hotwell Atmospheric Tower Feed Surge Drum Atmospheric Tower Overhead Accumulator Wash Water Surge Drum Water Seal Pot Water Collection Pot Fuel Gas K.O. Drum
FA-115 FA-116		Recycle Compressor K.O. Drum Preflash Tower Overhead Drum

## 3.0 <u>CAPITAL COSTS</u>

AREA 100 -	HYDROTREATER
TAG NO	DESCRIPTION
GA-101A/S GA-102A/S GA-103A/S GA-104A/S GA-105 GA-106A/S GA-107A/S	Feed Pump and Spare Naphtha Quench Pump and Spare HVGO Pump and Spare LVGO Pump and Spare Slop Oil Pump Sour Water Pump and Spare Atmospheric Tower Overhead Pump and Spare
GA-108A/S GA-109 GA-110 GA-111 GA-112A/S GA-113A/S	Vacuum Tower Bottoms Pump and Spare Reactor (DC-101) Recycle Pump Reactor (DC-102) Recycle Pump Reactor (DC-103) Recycle Pump Wash Water Pump and Spare HDS Feed Pump and Spare Fresh Feed Pump and Spare Preflash Tower Overhead Pump and Spare
GB-101A/S GB-102A/S	Recycle Compressor and Spare Fuel Gas Compressor and Spare
PA-101 PA-102A/S PA-103 PA-104	Vacuum Ejector Package Flame Arrester and Spare Corrosion Inhibitor Package Recycle Gas PSA Unit

AREA 200	HDS and JP8 PRODUCTION
TAG NO.	DESCRIPTION
BA-201 BA-202	HDS Feed Heater JP8 Tower Feed Heater
DA-201 DA-202 DA-203	JP8 Tower JP8 Product Stripper Naphtha Stabilizer
DC-201	HDS Reactor
EA-201 EA-202 EA-203 EA-204 EA-205 EA-206 EA-207 EA-208 EA-209 EA-210	HDS Reactor Feed/Effluent Exchanger JP8 Tower Feed/Bottoms Exchanger JP8 Tower Overhead Condenser Naphtha Stabilizer Feed/Bottoms Exchanger Naphtha Stabilizer Reboiler Naphtha Stabilizer Overhead Condenser Stabilized Naphtha Cooler Make-Up Hydrogen Compressor Circulation Cooler PSA Tail Gas Compressor After Cooler HDS Recycle Gas Compressor Circulation Cooler
EC-201 EC-202	HDS Reactor Effluent Condenser JP8 Product Cooler
FA-201 FA-202 FA-2C3 FA-204 FA-205 FA-206 FA-207 FA-208 FA-209	HDS Feed Surge Drum HDS Reactor Effluent HP/LT Separator HDS Recycle Gas Compressor Suction K.O. Drum JP8 Tower Feed Surge Drum JP8 Tower Overhead Reflux/Product Drum Naphtha Stabilizer Overhead Reflux Drum PSA Feed Gas K.O. Drum Make-Up Hydrogen Compressor Suction K.O. Drum PSA Tail Gas K.O. Drum
GA-203A/S	HDS Feed Pump and Spare JP8 Tower Overhead Reflux/Product Pump and Spare JP8 Product Pump and Spare JP8 Tower Bottoms and Spare Naphtha Stabilizer Reflux Pump and Spare HP Wash Water and Spare
GB-201A/S GB-202A/S GB-203A/S	HDS Recycle Gas Compressor and Spare Make-Up Hydrogen Compressor and Spare PSA Tail Gas Compressor and Spare
PA-201	Make-Up Hydrogen PSA Unit

AREA 300	<u>HYDROCRACKING</u> (525°F <sup>+</sup> FEED)
TAG NO.	DESCRIPTION
BA-301	HCR Feed Heater
DC-301	HCR Reactor
EA-301 EA-302	HCR Reactor Feed/Effluent Exchanger HCR Recycle Gas Compressor Circulation Cooler
EC-301	HCR Reactor Effluent Condenser
FA-301 FA-302 FA-303	HCR Feed Surge Drum HCR Reactor Effluent HP/LT Separator HCR Recycle Gas Compressor K.O. Drum
GA-301A/S	HCR Feed Pump and Spare
GB-301A/S	HCR Recycle Gas Compressor and Spare

AREA 400	STORAGE AREA
TAG NO.	DESCRIPTION
FB-401 FB-402 FB-403 FB-404 FB-405 FB-406 FB-407 FB-408 FB-409 FB-804 FB-805 FB-910 FB-912 FB-913 FB-913	JP-8 Jet Fuel Storage Tank Stabilized Naphtha Storage Tank Fuel Oil Storage Tank 300°F - Lt. Ends Storage Benzene Storage Toluene Storage Xylene Storage Gasoline Blend Storage Gasoline Storage Tar Product Storage Phenol Product Storage O-Cresol Storage M,P Cresol Storage 2,4/2,5 Xylenol Storage Mixed Xylenol Storage
GA-414A/S GA-415A/S	2,4/2,5 Xylenol Storage Mixed Xylenol Storage  Tar/Tar Oil Feed Pump Crude Phenol Feed Pump Fuel Oil Transfer Pump Stabilized Naphtha Transfer Pump Gasoline Blending Stock Pump Benzene Transfer Pump Toluene Transfer Pump Xylene Transfer Pump JP-8 Transfer Pump Gasoline Transfer Pump Gasoline Transfer Pump O-Cresol Transfer Pump M,P Cresol Transfer Pump 2,4/2,5 Xylenol Transfer Pump Mixed Xylenol Transfer Pump
PA-401	Gasoline Blending Package

AREA 500	CATALYST HANDLING
TAG NO.	DESCRIPTION
FA-501 FA-502 FA-503 FA-504	Catalyst Oil Drum Catalyst Storage Hopper Catalyst Transfer Vessel Spent Catalyst Vessels
FL-501	Catalyst Screen
GA-501A/S GA-502A/S	Catalyst Transfer Pump Catalyst Oil Pump
AREA 600	NAPHTHA DISTILLATION & HDT
EA-601 EA-602 EA-603 EA-604 EA-605 EA-606 EA-607 EA-608 EA-609	Naphtha Distillation Column Reboiler Naphtha Distillation Column Condenser HDT Reactor Feed/Effl. Exchanger HDT Reactor Recycle Gas Heater Stabilizer Feed Exchanger Reactor Effl. Cooler Stabilizer Reboiler Naphtha Stabilizer Condenser HDT Naphtha Cooler
FA-601 FA-602 FA-603 FA-604 FA-606 FA-607 FA-608	Crude Naphtha Feed Surge Drum Distillation Col'n Reflux Drum HDT Feed Surge Drum Make-Up Gas K.O. Drum LT/HP Separator Recycle Gas K.O. Drum Naphtha Stabilizer Reflux Drum
GA-601A/S GA-602A/S GA-603A/S GA-604A/S GA-605A/S GA-606A/S GA-607A/S GA-608A/S	Crude Naphtha Feed Pump Distillation Col'n Bottoms Pump Distillation Col'n Reflux Pump HDT Feed Pump Process Water Pump HDT Naphtha Pump Naphtha Stabilizer Reflux Pump Sour Water Pump
GB-601A/B GB-602A/B	Make-Up Gas Compressor Recycle Gas Compressor

AREA 700	AROMATICS RECOVERY
TAG NO.	DESCRIPTION
DA-701 DA-702 DA-703 DA-704 DA-705 DA-706 DA-707A/B DA-708	Extractor Column Raffinate Water Wash Column Stripper Recovery Column Water Stripper Solvent Regenerator Clay Tower Benzene Column
DA-709	Toluene Column
EA-701 EA-702 EA-703 EA-704 EA-705 EA-707 EA-708 EA-709 EA-710 EA-711 EA-712 EA-713 EA-714 EA-715 EA-716 EA-717 EA-718 EA-719 EA-720	Raffinate Cooler Lean/Rich Solvent Exchanger Stripper Reboiler Stripper Condenser Recovery Column Reboiler Recovery Column Intermediate Reboiler Recovery Column Condenser Recovery Column Ejector Condenser Water Stripper Reboiler Solvent Regenerator Reboiler Solvent Cooler Clay Tower Feed/Effl. Exchanger Clay Tower Feed Heater Benzene Column Reboiler Benzene Column Condenser Toluene Column Reboiler Xylene Product Cooler Toluene Column Condenser Toluene Product Cooler
EE-701	Recovery Column Ejector
FA-701 FA-702 FA-703 FA-704 FA-705 FA-706 FA-708 FA-709	Feed Surge Drum Stripper Reflux Drum Recovery Column Reflux Drum Ejector Condensate Drum Solvent Sump Vent K.O. Drum Benzene Column Reflux Drum Toluene Column Reflux Drum

3.1 Equipment Lists (cont'd)

## AREA 700

FB-701 FB-702 FB-703 FB-704 FB-705 FB-706A/B	Solvent Storage Tank Wet Solvent Storage Tank Clay Tower Surge Tank Benzene Day Tank Xylene Day Tank Toluene Day Tanks
FD-701	Solvent Filter
GA-701A/S GA-702A/S GA-703A/S GA-704A/S GA-705A/S GA-705A/S GA-706A/S GA-708A/S GA-708A/S GA-710A/S GA-711A/S GA-711A/S GA-715A/S GA-715A/S GA-715A/S GA-715A/S GA-718A/S GA-719A/S GA-719A/S GA-719A/S GA-723A/S GA-723A/S	Feed Charge Pump Pumparound Pump Raffinate Pump Stripper Bottoms Pump Stripper Water Pump Extractor Recycle Pump Lean Solvent Pump Wash Water Pump Recovery Column Overhead Pump Water Stripper Bottoms Pump Ejector Condensate Pump Solvent Transfer Pump Wet Solvent Pump Solvent Sump Pump (Warehouse Spare) Clay Tower Feed Pump Benzene Column Bottoms Pump Benzene Column Reflux Pump Benzene Product Pump Toluene Column Bottoms Pump Toluene Column Reflux Pump Toluene Product Pump
PA-701	Clay Handling Equipment

AREAS 800 & 850	PHENOL AND CRESYLIC ACID EXTRACTION
TAG NO.	DESCRIPTION
DA-801	Flash Column
DA-802	Drier Column
DA-803	Phenol Column
DA-804	Stripping Column
DA-805	Light Ends Column
DA-851	Extractor Column
DA-852	Hexane Column
DA-853	Methanol Column
DA-854	Drying Column
EA-801	Flash Column Condenser
EA-802	Flash Column Reboiler
EA-803	Dephenolized Cresylic Acid Cooler
EA-804	Flash Column Trim Cooler
EA-805	Dryer Condenser
EA-806	Phenol Column Reboiler
EA-807	Phenol Column Condenser
EA-808	Light Ends Column Condenser
EA-809	Light Ends Column Reboiler
EA-810	Stripping Column Condenser
EA-811	Stripping Column Reboiler
EA-812	Phenol Cooler
EA-813	Tar Cooler
EA-814	Stripping Column Side Reboiler
EA-851	Hexane Reboiler
EA-852	Hexane Condenser
EA-853	Neutral Oil Cooler
EA-854	Methanol Reboiler
EA-855	Methanol Condenser
EA-856	Methanol Column Bottoms Cooler
EA-857	Drying Column Reboiler
EA-858	Drying Column Condenser
EA-859	Crude Cresylic Acid Cooler
EA-860	65% Methanol Cooler
EA-861	Methanol Column Feed/Crude Cresylic Acid Interchanger
ED-801	Thin Film Evaporator

AREAS 800 & 850	PHENOL AND CRESYLIC ACID EXTRACTION
TAG NO.	DESCRIPTION
FA-801 FA-802 FA-803 FA-804 FA-805 FA-806 FA-807 FA-808 FA-809 FA-851 FA-852 FA-853 FA-854	Flash Column Reflux Drum Dryer Drum Phenol Column Reflux Drum Stripping Column Reflux Drum Light Ends Column Reflux Drum Crude Phenol Surge Drum Cresylic Acid Drum Phenol Drawoff Drum Light Ends Drum Hexane Reflux Drum Methanol Column Reflux Drum Drying Column Reflux Drum Methanol Make-Up Drum
FB-801 FB-802 FB-803 FB-851 FB-852 FB-853A/B	Sulfuric Acid Day Tank Tar Day Tank Phenol Day Tank Hexane Storage Tank Crude Cresylic Acid Day Tank Crude Cresylic Acid Month Storage Tank
FD-801 FD-802	lst Stage Water Wash Tank 2nd Stage Water Wash Tank
GA-801A/S GA-802A/S GA-803A/S GA-804A/S GA-805A/S GA-806A/S GA-808A/S GA-809A/S GA-810A/S GA-811A/S GA-812A/S GA-813A/S	Crude Phenol Feed Pump Flash Column Reflux Pump Flash Column Bottoms Pump Acid Tar Pump Flash Column Water Pump Light Ends Column Feed Pump Sulfuric Acid Pump Cresylic Acid Pump Light Ends Column Reflux Pump Light Ends Column Bottoms Pump Dryer Water Pump Dryer Reflux Pump Phenol Column Reflux Pump
GA-813A/S GA-814A/S GA-815A/S GA-816A/S GA-817A/S GA-818A/S GA-819A/S GA-820A/S	Phenol Column Reflux Pump Phenol Drawoff Pump Phenol Column Bottoms Pump Stripping Column Reflux Pump Stripping Column Organic Extraction Pump Stripping Column Bottoms Pump Phenol Charge Pump Dryer Column Bottoms Pump

AREAS 800 & 850	PHENOL AND CRESYLIC ACID EXTRACTION
GA-825A/S GA-826A/S GA-851A/S GA-852A/S GA-853A/S GA-855A/S GA-855A/S GA-856A/S GA-857A/S GA-858A/S GA-858	Wash Water Pump Tar Circulating Pump Wash Water Circulating Pump Tar Pump Tar Storage Pump Light Ends Column Water Pump Extractor Bottoms Pump Hexane Column Bottoms Pump Hexane Feed Pump Hexane Make-Up Pump Methanol Column Bottoms Pump Methanol Column Reflux Pump Drying Column Feed Pump Drying Column Feed Pump Crude Cresylic Acid Pump Drying Column Condensate Pump Crude Cresylic Acid Supply Pump
GD-801 GD-802 GD-803 GD-851	lst Stage Wash Tank Mixer 2nd Stage Wash Tank Mixer Sulfuric Acid Mixer Extractor Mixer
PA-801	Vacuum System

## 3.0 CAPITAL COSTS

# 3.1 Equipment Lists (cont'd)

AREA 900	CRESYLIC ACID DISTILLATION	<u>,</u>
TAG NO.	DESCRIPTION	
	BLOCK OPERATION 1	BLOCK OPERATION 2
DA-901 DA-902A/B DA-903 DA-904	Phenol/Ortho Column Phenol Column M,P Cresol Column Xylenol Top. Column	O-Cres. Top. Column O-Cres. Column 2,4/2,5-Xylenol Col.
EA-901 EA-902 EA-903 EA-904 EA-905 EA-906 EA-907 EA-908 EA-909 EA-910 EA-911 EA-911 EA-912 EA-913 EA-915	Phenol/Ortho Col. Reb. Phenol/Ortho Condenser Phenol Column Reb. Phenol Column Cond. M,P Cres. Col. Reb. M,P Cres. Col. Cond. Xylenol Top. Col. Reb. Xylenol Top. Col. Cond. Phen./Ortho Col. Feed. Btms. Interchanger Phenol Col. Btms Cool. Xyl. Top. Col. Btms Cool. M,P Cres. Prod. Cool.	O-Cres. Top Col. Reb. O-Cres. Top Condenser O-Cres. Col. Reboiler O-Cres. Col. Condenser 2,4/2,5-Xyl. Col. Reb. 2,4/2,5-Xyl. Col. Cond O-Cres. Top. Column Feed-Btms. Interchanger O-Cres. Col. Btms. Cool. 2,4/2,5 Xyl. Col Btms Cool O-Cres. Top. Col O/H Cool O-Cres. Product Cooler Xyl. Col. Feed Btms Intchg. 2,4/2,5-Xyl. Prod. Cool.
FA-901 FA-902 FA-903 FA-904	Phen/Ortho Reflux Drum Phenol Reflux Drum M,P Cres. Reflux Drum Xyl. Top. Reflux Drum	O-Cres. Top. Reflux Drum O-Cres. Reflux Drum 2,4/2,5 Xyl. Ref. Drum
FB-901  FB-902 FB-903 FB-905 FB-906 FB-907 FB-908 FB-909 FB-910 FB-911 FB-912 FB-913 FB-914	O-Cresol Top. Feed Day Tank Xyl. Intermed. Day Tank M,P Cresol Day Tank O-Cresol Topping Feed Month S Xylenol Intermediate Month St O-Cresol Month Storage Slop Cut Month Storage M,P Cresol Month Storage 2,4/2,5 Xylenol Month Storage Mixed Xylenol Month Storage	orage
	TAG NO.  DA-901 DA-902A/B DA-903 DA-904  EA-901 EA-902 EA-903 EA-904 EA-905 EA-907 EA-908 EA-909  EA-910 EA-911 EA-912 EA-913 EA-914 EA-915 EA-916  FA-901 FA-902 FA-903 FA-904 FB-901 FB-902 FB-903 FB-907 FB-908 FB-907 FB-908 FB-907 FB-908 FB-907 FB-908 FB-907 FB-908 FB-909 FB-910 FB-911 FB-912 FB-913	TAG NO.  BLOCK OPERATION 1  DA-901 DA-902A/B DA-903 DA-904  EA-901 EA-901 Phenol/Ortho Column DA-903 DA-904  EA-901 Phenol/Ortho Col. Reb. Phenol/Ortho Condenser Phenol/Ortho Column Reb. Phenol Column Reb. Phenol Column Cond. Phenol Col. Reb. Phenol Col. Bed. Phenol Col. Feed. Phenol Col. Btms Cool. Phenol Col. Btms Phenol

# 3.0 CAPITAL COSTS

# 3.1 Equipment Lists (cont'd)

AREA 900	CRESYLIC ACID DISTILLA	TION
TAG NO.	DESCRIPTION	
	BLOCK OPERATION 1	BLOCK OPERATION 2
GA-901A/S GA-902A/S GA-903A/S GA-904A/S GA-905A/S GA-908 GA-909 GA-910 GA-911 GA-912 GA-913 GA-914A/S GA-915A/S GA-915A/S GA-917A/S GA-918A/S	Phenol/Ortho Btms Pump Phenol/Ortho Reflux Pump Phenol Bottoms Pump Phenol Reflux Pump M,P Cres. Btms. Pump M,P Cres. Reflux Pump O-Cres. Topping Pump M,P Cresol Pump Xylenol Pump Phen Col Intermed. Pump Xyl. Top. Btms. Pump Xyl. Top Return Pump	O-Cres. Top. Bottoms Pump O-Cres. Top. Reflux Pump O-Cres. Bottoms Pump O-Cres. Reflux Pump Mixed Xylenol Pump 2,4/2,5 Xylenol Pump O-Cresol Pump O-Cres. Col. Inter. Pump 2,4/2,5 Xyl. Btms. Pump 2,4/2,5 Xyl. Rflx.Pump O-Cres. Top. Col. Feed Xylenol Col. Feed Pump
PA-901	Vacuum Package	

#### 3.2 Cost Estimate

#### 3.2.1 Basis of Estimate

The estimates for all areas are equipment factored estimates. Data was developed for the equipment based on the processing schemes and then priced using in-house return cost data for similar equipment items. This equipment value was then used to establish the cost of materials and labor using historical ratio's of such costs. Engineering was calculated based on the number of equipment items. Contingency was added at 20% of the total costs. For Areas 500, 600 and 700 the Task 1.2 previous estimates are used, and escalated.

Excluded from this estimate are:

Spare Parts Start-Up Insurances & Taxes Permits Royalties on Processing Technology Knowhow

#### 3.2.2 Estimate Summary

(	Ihou	sands	ot	\$)

Area 200 Area 300 Area 400	· · • -	\$ 25,992 34,761 5,803 12,802 1,409	
Area 600 Area 700 Area 800 Area 850	Naph. Dist & HDT	5,403 10,338 11,909 5,361 7,508	
Area 700	ARU Solvent Invent. Total	\$121,287 110 \$121,397	

## 3.2 Cost Estimate (cont'd)

#### 3.2.3 ESTIMATE BREAKDOWN

The following pages show the estimate breakdown for each Area. The backup for the estimate can be found in Section 6 along with the equipment data.

CLIENT: DOE

PROJECT: 5571

LOCATION: BEULAH, ND.

PAGE: 1

PROJECT: JET FUEL

<u>DATE/BY:</u> 21-Apr-89

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EQUIPMENT

PCS. \$ EQUIP.

\* COMM

S COMM

HEATERS TOWERS INTERNALS
REACTORS
EXCHANGERS
AIR COOLERS
VESSELS
TANKS
<u>FILTERS</u>
PUMPS
COMPRESSORS
PACKAGE UNITS
TOTAL

2	\$485	80%	\$388
3	\$80	110%	\$88
	\$16		
3	\$2,100	60%	\$1,260
8	\$84	120%	\$101
2	\$116	90%	\$104
16	\$266	100%	\$266
30	\$900	100%	\$900
4	\$1,700	60%	\$1,020
4	\$45	60%	\$27
72	\$5,792		\$4,154

#### SUMMARY

EQUIPMENT

\$5,792

COMMODITIES

\$4,154

LABOR

\$3,072 (10% EQUIP,60% COMM)

INDIRECTS

\$3,072 (100% LABOR)

ENGINEERING

\$4,320 (1000/PC X \$60)

SUBTOTAL

\$20,410

CONTINGENCY

\$4,082 (20%)

TOTAL

\$24,492

PSA

\$1,500 PSA 5MM X 1.5 TIC

TOTAL

\$25,992

CLIENT: DOE

PROJECT: 5571

LOCATION: BEULAH. ND.

PAGE: 1

PROJECT: JET FUEL

<u>DATE/BY:</u> 21-Apr-89

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**EQUIPMENT** 

# PCS. \$ EOUIP.

& COMM S COMM

HEATERS
TOWERS
INTERNALS
REACTORS
EXCHANGERS
AIR COOLERS
VESSELS
TANKS
FILTERS
PUMPS
COMPRESSORS
PACKAGE UNITS

TOTAL

2	\$370	60%	\$222
3	\$81	110%	\$89
	\$19		
1	\$900	70%	\$630
10	\$376	90%	\$338
2	\$88	90% .	\$79
9	\$266	100%	\$266
12	\$315	100%	\$315
6	\$5,100	60%	\$3,060
45	\$7,515		\$5,000

SUMMARY

EQUIPMENT

\$7,515

COMMODITIES

\$5,000

LABOR

\$3,751 (10% EQUIP,60% COMM)

INDIRECTS

\$3,751 (100% LABOR)

**ENGINEERING** 

\$2,700 (1000/PC X \$60)

SUBTOTAL

\$22,717

CONTINGENCY

\$4,543 (20%)

TOTAL

\$27,261

PSA

\$7,500 PSA 5MM X 1.5 TIC

TOTAL

\$34,761

CLIENT: DOE

PROJECT: 5571

LOCATION: BEULAH, ND.

PAGE: 1

PROJECT: JET FUEL

DATE/BY: 21-Apr-89

03:05 PM

**EQUIPMENT** 

PCS. S EOUIP. S COMM

\$ COMM

**HEATERS** TOWERS INTERNALS REACTORS **EXCHANGERS** AIR COOLERS **VESSELS** TANKS **FILTERS PUMPS** COMPRESSORS PACKAGE UNITS

12	\$1,360		\$1,129
2	\$400	80%	\$320
2	\$100	100%	\$100
3	\$85	120%	\$102
1	\$70	100%	\$70
2	\$85	100%	\$85
1	\$560	70%	\$392
		110\$	
1	\$60	100\$	\$60

TOTAL

## SUMMARY

EQUIPMENT

\$1,360

COMMODITIES

\$1,129

LABOR

\$813 (10% EQUIP, 60% COMM)

INDIRECTS

\$813 (100% LABOR)

ENGINEERING

\$720 (1000/PC X \$60)

SUBTOTAL

\$4,836

CONTINGENCY

\$967 (20%)

TOTAL

\$5,803

# OSBL ESTIMATE

### **PIPING**

600 TONS X 1.1 FOR FITTINGS & FLANGES 2000 GALV. @ \$25/FT LABOR @ .6 HRS/FT. X \$55/HR (80000) TRACING 16200 LP @ \$20/FT  INSULATION		\$1,320,000 \$50,000 \$2,640,000 \$324,000
FROM BACK UP PIPERACK		\$420,000
3000LF @ \$300/FT CONCRETE 1500 Y3 X \$350/		\$900,000 \$525,000
TOTAL INTERCONNECTIONS		\$6,179,000
EQUIPMENT		\$1,846,000
INSTALLATION MATERIALS FOR EQUIPMENT @	25\$	\$461,500
LABOR FOR EQUIPMENT & MATERIALS		\$461,500
	<u>s/T</u>	\$8,948,000
ENGINEERING @ 10 %		\$900,000
	S/T	\$9,848,000
CONTINGENCY @ 30%		\$2,954,400
	TOTAL	\$12,802,400

EQUIPMENT	# PCS.	\$ EQUIP.	\$ COMM	\$ COMM
HEATERS TOWERS INTERNALS REACTORS EXCHANGERS AIR COOLERS VESSELS TANKS FILTERS PUMPS COMPRESSORS PACKAGE UNITS	4		105 12	
TOTAL	8	\$	153	\$184

#### SUMMARY

EOUIPMENT \$153 COMMODITIES \$184

<u>LABOR</u> \$125 (10% EQUIP, 60% COMM)

INDIRECTS \$125 (100% LABOR)

**ENGINEERING** \$480 (1000/PC X \$60)

SUBTOTAL \$1,068

CONTINGENCY \$214 (20%)

TOTAL \$1,281

ESCALATION \$128 10%

<u>TOTAL</u> \$1,409

EQUIPMENT	# PCS.	\$ EQUIP.	\$ COMM	\$ COMM
HEATERS				
TOWERS	2	\$48	140	\$67
<u>INTERNALS</u>		\$8		
<u>REACTORS</u>	L			
<b>EXCHANGERS</b>	1	\$125	851	\$106
AIR COOLERS				
<u>VESSELS</u>	9	\$123	1001	\$123
TANKS	7	\$89	1001	\$89
<u>FILTERS</u>				
PUMPS	16	\$68	100	\$68
COMPRESSORS	4	\$230	601	\$138
PACKAGE UNITS				<u> </u>
TOTAL	39	\$691		\$591

#### SUMMARY

EQUIPMENT \$691

COMMODITIES \$591

<u>LABOR</u> \$424 (10% EQUIP, 60% COMM)

INDIRECTS \$424 (100% LABOR)

**ENGINEERING** \$1,872 (800/PC X \$60)

SUBTOTAL \$4,002

<u>CONTINGENCY</u> \$800 (20%)

**TOTAL** \$4,803

**ESCALATION** \$600 12.5%

**TOTAL** \$5,403

EQUIPMENT	# PCS.	\$ EOUIP.	\$ COMM	\$ COMM
HEATERS TOWERS	10	\$350	1404	\$490
INTERNALS	10	\$66	1401	
REACTORS				
EXCHANGERS	20	\$113	100	\$113
AIR COOLERS				
<u>VESSELS</u>	9	\$65	1204	
<u>Tanks</u>	7	\$117	100	\$117
FILTERS				
PUMPS	44	\$180	120	\$216
COMPRESSORS			609	
PACKAGE UNITS	3	\$20	1009	\$20
TOTAL	93	\$911		\$1,034

### SUMMARY

EQUIPMENT \$911

COMMODITIES \$1,034

<u>LABOR</u> \$712 (10% EQUIP,60% COMM)

INDIRECTS \$712 (100% LABOR)

ENGINEERING \$4,464 (800/PC X \$60)

**SUBTOTAL** \$7,832

<u>CONTINGENCY</u> \$1,566 (20%)

TOTAL \$9,398

**ESCALATION** \$940 10.0%

TOTAL \$10,338

EQUIPMENT	PCS.	\$ EQUIP.	1 COMM	\$ COMM
HEATERS				
TOWERS	5	\$776	1009	\$776
<u>INTERNALS</u>		\$143	01	\$0
REACTORS			901	\$0
EXCHANGERS	14	\$332	1001	\$332
<u>VESSELS</u>	9	\$73	120	\$88
TANKS	3	\$53	801	\$42
<u>FILTERS</u>				\$0
<u>PUMPS</u>	52	\$440	1001	\$440
COMPRESSORS				
PACKAGE UNITS	7	\$165	701	\$115
TOTAL	90	\$1,982		\$1,794

#### SUMMARY

EQUIPMENT \$1,982

COMMODITIES \$1,794

<u>LABOR</u> \$1,274 (10% EQUIP,60% COMM)

<u>INDIRECTS</u> \$1,274 (100% LABOR)

ENGINEERING \$3,600 (800/PC X \$50)

SUBTOTAL \$9,924

<u>CONTINGENCY</u> \$1,985 (20%)

<u>TOTAL</u> \$11,909

EQUIPMENT	PCS.	\$ EOUIP.	\$ CONN	\$ COMM
HEATERS	Γ	Ţ	<u> </u>	
TOWERS	4	\$115	1001	\$115
INTERNALS		\$281		
REACTORS				
EXCHANGERS	11	\$167	120	\$200
VESSELS	9	\$25	120	\$30
TANKS	3	\$127	801	\$102
<u>FILTERS</u>				
PUMPS	23	\$173	110	\$190
COMPRESSORS				
PACKAGE UNITS			<b></b>	
TOTAL	50	\$888		\$637

#### SUMMARY

EQUIPMENT \$888 COMMODITIES \$637 LABOR \$471 (10% EQUIP,60% COMM) INDIRECTS \$471 (100% LABOR) ENGINEERING \$2,000 (800/PC X \$50) SUBTOTAL \$4,468 \$894 (20%) CONTINGENCY TOTAL \$5,361

EQUIPMENT	PCS.	\$ EQUIP.	& COMM	\$ COMM
W. 1 M. 10 A	r		·	<del></del>
<u>HEATERS</u>		<u> </u>		
TOWERS	5	\$453	1001	\$453
<u>INTERNALS</u>		\$218		
REACTORS				
<b>EXCHANGERS</b>	16	\$220	1101	\$242
<u>VESSELS</u>	4	\$19	120	\$23
TANKS	6	\$69	80	\$55
<u>FILTERS</u>				
<u>PUMPS</u>	28	\$210	1101	\$231
COMPRESSORS	2	\$50	110	\$55
PACKAGE UNITS				
TOTAL	61	\$1,239		\$1,059

#### <u>SUMMARY</u>

EQUIPMENT \$1,239

COMMODITIES \$1,059

<u>LABOR</u> \$759 (10% EQUIP,60% COMM)

INDIRECTS \$759 (100% LABOR)

**ENGINEERING** \$2,440 (800/PC X \$50)

SUBTOTAL \$6,257

<u>CONTINGENCY</u> \$1,251 (20%)

**TOTAL** \$7,508

#### 4.0 **OPERATING COSTS**

### 4.1 Operating Labor

It is estimated that it will require 17 men/shift to operate the plant broken down as follows:

Foreman Control Room HDT Operator HDS & JP-8 Operator HCR Operator Naph. Distill. & HDT Operator ARU Phenol Extraction Cresylic Acid Extraction	2 2 2 1 2 2 1
Cresylic Acid Distillation Relief Man	1
Shift Positions	17

hift Positions

Maintenance will be integrated with the existing SNG Plant Maintenance Shop. The existing maintenance department will most likely be expanded by about 10 people.

The total additional people (assuming 6 & 2 operation for the process units) are as follows:

Shift P	Personnel	17 Positions	X	4	
		People/Posit	ion	=	68
Supervi	sor & Admin	•			6
QC Tech	nician				2
Mainten	ance				10
Other	(Stores or	Janitorial)			1
Total					87

4.2 <u>Utilities</u>

The following utility requirements have been developed:

UTILITY	CONSUMPTION	COST		\$/CD
#6 Fuel Oil	3904 BPCD	\$16/BBL	(a)	62464
SNG Equivalent of SYN Gas & Purge Gas	3.76 MMSCFD	\$3.80/MM BTU	(b)	14000
Cooling Water	8063 GPM	<b>\$</b> 0.155/MGAL	(c)	1800
Power	7230 KW	\$0.04/KWH	(c)	6940
Process Water	90 GPM	<b>\$</b> 0.45/MGAL	(c)	58
HP Steam (550#)	63700 #/H	\$5/M LBS.	(c)	7644
MP Steam (100#)	31400 #/H	\$2.50/MLBS	(c)	1884
LP Steam (40#)	(13732 #/H)	\$2.50/MLBS	(c)	(824)
BFW	11800 #/H	\$2.66/MGAL	(c)	91
Condensate Return	(92360 #/H)	\$1.87/MGAL	(c)	(495)

<sup>(</sup>a) Cost of 1% sulfur #6 oil in Minnesota on 11/24/87 as per Platts Oilgram.

<sup>(</sup>b) Memo from D. Daley of Burns & Roe to L. Lorenzo of DOE dated October 20, 1987 reference DPD-87-863.

<sup>(</sup>c) ANG utility cost information dated 5/87.

#### 4.2 Utilities - cont'd

#### 4.3 Catalyst & Chemicals

The catalyst and chemicals cost is as follows:

Catalyst & Chem.	<u>Use</u>	Cost	\$/CD
Nap. HDT Cat. HDT Cat. HDS Cat. HCR Cat. Inhibitors ARU Solvent H <sub>2</sub> SO <sub>4</sub>	0.021 #/Bb1 0.2 #/Bb1 0.038 #/Bb1 0.053 #/Bb1 50 PPM 24 #/D 2650 #/D	\$3.00/# \$3.00/# \$3.30/# \$6.00/# \$10/Gal \$2.10/# \$0.04/#	30 1671 368 491 60 60 106
•			2786

#### 4.4 Maintenance Supplies

Maintenance supplies for hydrotreating operations typically cost between 1.5-2.0% of the installed cost per year. For a daily cost we would estimate the cost of maintenance supplies to be 0.005% of the total installed cost of the process units (excluding the ARU solvent inventory). On this basis the maintenance supplies would be:

 $\frac{0.02}{365}$  (121,287,000) (0.91) = \$6048/CD.

### APPENDIX E

LCI Report on "Profitable JP-8" Design:
Plot Plan and Tie-ins

#### 5.0 PLOT PLAN AND UNIT TIE-INS

#### 5.1 Plot Plan

The process units required for the production of JP-8 and by-product chemicals are proposed to be located to the east of the Rectisol Unit of the existing gasification plant as indicated on the markup of the overall Process Area Plot Plan, LCI Dwg E7102-00010A. This area approximately 400 x 600' will be surrounded by an access road and will be divided by two central east-west roads. Areas 100, 200 and 300 will be located to the north and Areas 800, 850 and 900 south of Area 100, and then Areas 600 and 700. The 500 Area equipment is located within Area 100. Adjacent to the 700 Area is a intermediate storage tank area that is utilized with the blocked operation of Area 900 Cresylic Acid Distillation.

A diked storage tank area approximately 375' x 425' will be required for product and fuel oil storage and is proposed to be located to the south of the existing tankage area adjacent to the railcar loading spurs.

#### 5.2 Unit Tie-Ins

Approximately 3000 ft of new interconnecting pipe rack will be required to connect the new process area with the main yard rack of the gasification plant, the product storage area and flare.

New storm, oily water and sanitary sewer lines will be run from the new process units south to their respective collection systems.

A summary of the interconnecting lines is shown in Table 5.1.

# TABLE 5.1

# INTERCONNECTING PIPING

# I. TAR OIL STREAM

EST. SIZE	SERVICE	TO/FROM
4" 3" 2" 8" 6" 2" 1 1/2" 1 1/2" 4" 3"	Tar/Tar Oil (Elec. Tr.) JP-8 Product Stabil. Naph. Product Synthesis Gas Purge Gas Waste Water 300° F. Lt. Ends Vac. Twr. Btms. & Slop Off Gas Off Gas	Storage Storage Storage PSA/Rectisol Methanation/PSA Phosam/HDT, HDC Storage Fuel Fuel Gas LP. Fuel.
	****	

# TABLE 5.1 - cont'd

# INTERCONNECTING PIPING

# II. NAPHTHA STREAM

EST. SIZE	SERVICE	TO/FROM
1 1/2" 1 1/2" 1 1/2" 1 1/2" 1 1/2" 1 1/2" 1 1/2" 3" 3" 1 1/2" 2"	Crude Naphtha 160 f - Distillate Blending Stock Benzene Toluene Xylene Butane Gasoline Purge Gas Off Gas Waste Water	Storage Storage/Dist. Storage/ARU Storage/ARU Storage/ARU Storage/ARU Storage Storage Fuel Gas/PSA & HDT Rectisol/HDT Phosam/HDT

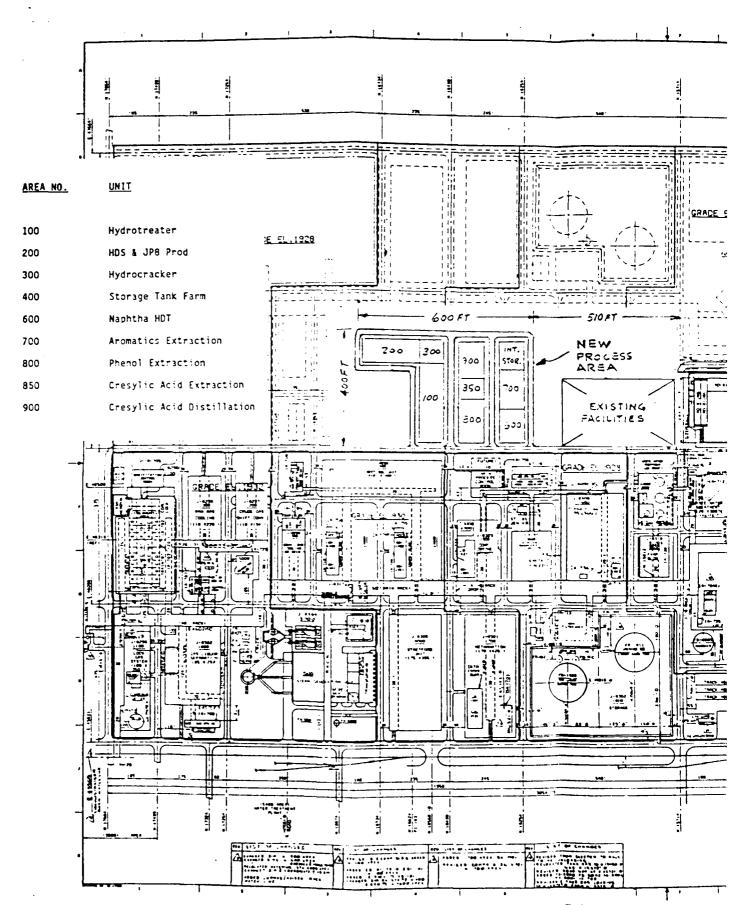
## LCI PROJECT 5571 TASK 4.0

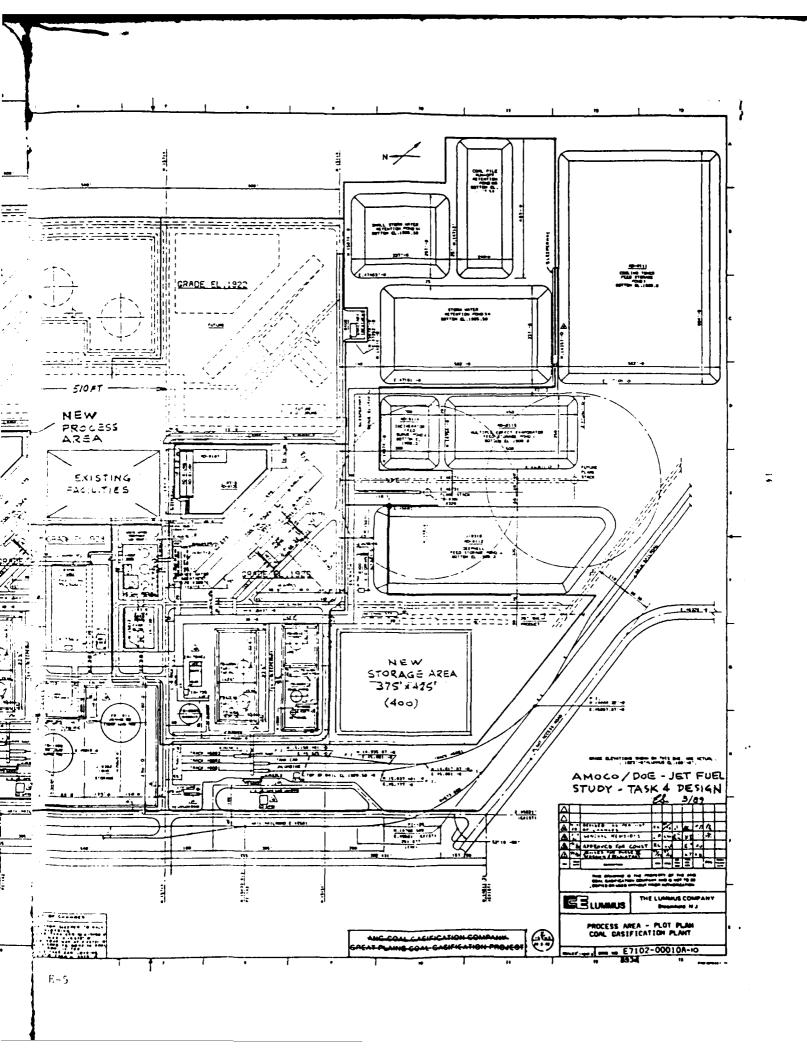
## TABLE 5.1

### INTERCONNECTING PIPING

III.	PHENOL STREAM	INTERCONNECTING PIPING	
	EST. SIZE	SERVICE	TO/FROM
	2" 2" 3" 2" 1 1/2" 1 1/2" 1 1/2" 1 1/2" 1 1/2" 1 1/2" 1 1/2" 1 1/2"	Crude Phenol (Elec. Tr.) Tar Product Phenol Product (Elec. Tr.) Crude Cresylic Acid (Elec. Tr.) Crude O-Cresol (Elec. Tr.) Crude Xylenol (Elec. Tr.) Crude Cresylic Acid (Elec. Tr.) Slop (Elec. Tr.) Extraction Purge O-Cresol (Elec. Tr.) M,P-Cresol (Elec. Tr.) 2,4/2,5 Xylenol Product (Elec. Tr.) Mixed Xylenol Prod. (Elec. Tr.)	Storage Storage Storage Int. Storage & Return Fuel/Ph. Ext. Storage Storage
	1 1/2" 1 1/2" 1 1/2" 3" 1 1/2" 2"	Methanol Make-Up Sulfuric Acid (Elec Tr.) Wash Water (Elec. Tr.) Waste Water (Elec. Tr.) Off Gas	Storage Ph. Ext./MeoH Unit Ph. Ext./Storage Treatment/Ph. Ext. Phenosolvan/Ph. Ext. LP Fuel Gas
IV.	COLUMN_LINES		
	EST. SIZE	SERVICE	TO/FROM
	30" 3" 3" 2" 8" 20" 2" 4" 1 1/2" 26"	Wet Flare (Trace) Nitrogen Plant Air Instr. Air Raw Water (Elec. Trace) HP Steam MP Steam C. W. Supply and Return BFW Cond. Return Boiler B.D. Storm Sewer (8' Deep) Oily Water Sewer (8' Deep)	Flare Main Rack Storm Basin/ Process Units 8100/Process Units
	6" 10" <b>4</b> "	Sanitary Sewer (9' Deep) Fire Water Fuel Oil (Elec. Trace)	8400/Process Units Rins Header Day Tank/Storage

RR5571-5.TXT





#### APPENDIX F

LCI Report on "Profitable JP-8" Design: Equipment Data and Estimate Sheets

# 6.0 EQUIPMENT DATA AND ESTIMATE SHEETS

# 6.1 Tar Oil Stream

- 6.1.1 AREA 100
- 6.1.2 AREA 200
- 6.1.3 AREA 300
- 6.1.4 AREA 500

CLIENT: DOE

PROJECT: 5571

LOCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

21-Apr-89

03:31 PM

**EQUIPMENT** 

# PCS. \$ EOUIP. \$ COMM

\$ COMM

<u>HEATERS</u>
TOWERS
INTERNALS
REACTORS
EXCHANGERS
AIR COOLERS
VESSELS
TANKS
FILTERS
PUMPS
<u>COMPRESSORS</u>
PACKAGE UNITS
TOTAL

2	\$485	80%	\$388
3	\$80	110%	\$88
	\$16		
3	\$2,100	60%	\$1,260
8	\$84	120%	\$101
2	\$116	90%	\$104
16	\$266	100%	\$266
30	\$900	100%	\$900
4	\$1,700	60₹	\$1,020
4	\$45	60%	\$27
72	\$5,792		\$4,154

SUMMARY

EQUIPMENT

\$5,792

COMMODITIES

\$4,154

LABOR

\$3,072 (10% EQUIP,60% COMM)

INDIRECTS

\$3,072 (100% LABOR)

**ENGINEERING** 

\$4,320 (1000/PC X \$60)

SUBTOTAL

\$20,410

CONTINGENCY

\$4,082 (20%)

TOTAL

\$24,492

PSA

\$1,500 PSA 5MM X 1.5 TIC

TOTAL

\$25,992

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2 SIZE IN DA		TYPE DOUBLE APPE	-							Γ
3 NO SHELL/SERV.	,	TOTAL SOFT 80 ISERV	£	80 SOFT		5000				
4 NO SHELL/SERV	RV. m <sup>2</sup> /SHELL	TOTAL m2 /SERV	<u></u>	Sm.		+				T
9	SHELL SIDE C.A.	TUBE SIDE C.A.	E							T
6 MAY	6.3	\$2				_				T
7 DES PRESS	75 PSG/ LEE	800 PSIG/	hPe.							
R DES TEMP	30 /se /29	550 of	ပ္							T
9 TUBES: DIA	GA MIN AV WELDED	D THOOL & THE CONT								
10 TUBE ENDS: 1	TUBE ENDS: WELDED []NO. TUBES []INS	NSUL [3] ERECT WT	L	TONSEA						T
11 EA. 102 (	LVGO COUDENSER									Ī
12 SIZE-IN. D/L	mm D/L	TYPE DOUBLE PIPE								T
13 NO SHELL/SERV.	RV. / SOFT/SHELL	TOTAL SOFT /00 /SERV	^	/00 SOFT		5 000				T
14 NO SHELL/SERV.	RV. m²46HELL	TOTAL m2 /SERV	>	3						
20	SHELL SIDE C.A.	TUBE SIDE C.A.	Light.							T
PAAT	55	(5)								Γ
	7.5 PSIG/ "METER?	3	J-1							
	500 0F/ oc	150 or/	٥٥							T
*D TUBES: DIA	) WEL	D SMLS CEXP JOINT								Γ
20 TUBE ENDS:1	1 1	NSUL [K] ERECT. WT	<u>П</u>	TONS EA						
	40T 10 16P. UAPOR/S	STEATH GENERATOR				_				Γ
22 SIZE-IM. D/L	man D/L	•								
_	,	TOTAL SO FT BS O ISERV	>	850 Sart	152	2 000				Ţ
24 NO SHELL/SERV	RV. m <sup>2</sup> /5HELL	TOTAL m2 /SERV	^	Z.W		T				
8	SHELL SIDE C.A. " M" mm	TUBE SIDE C.A. "B"	mm							Ī
_	B	5.5				_				
27 DES PRESS	800 FSIG/	450 PSIG/ 1995	m.2			_				
28 DES TEMP	650 %/ °C	30 /30 059								
29 TUBES: DIA	J WEI	D SMLS CEXP JOINT								Π
30 TUBE ENDS	ED []NO. TUBES	JINSUL & ERECT. WT	1	TONS EA		_				Τ
TOTAL THIS PAGE										Τ
TOTAL ACCOUNT	WAT									
CLIENT AN	CLIENT AMOCO (DOE - GEENT PLAN	INS GASIF. PANZ PROD FACT	ACT	1 00 1		à	35	100 m 55	12	ACCT
LOCATION	LOCATION BEVLASS NORTH DI				_	DATE	2/21/28	EST NO		EA
PROJECT JE	MONECT JET FILE FROM COAL DEPIVED LIRUIDS	PLUED LIRUIDS WAGERATE	IATE	LAB. COST		nfv	7		•	
										į

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				ESTIMATE SHEET	SHEE	-				THE LUMMUS COMPANY	S COMPANY	
									F		BIODAM MIG	T
·		DESCRIPTION	•		3	DUANTITY	UNIT	MATERIAL		STD LABOR MH .	SUSCONTRAC	¥ç
					afo 0	TOTAL	3	1893	CNIT	TOTAL	COST	
1 EA. 104	401 L P	VAPOR/8FW	<b>EXCHANGER</b>	ER.	   							·
2 SIZE-IN. DAL		mm D/L	TYPE	E AEU								Γ
3MO SHELL/SERV. /	RV. /	SO FT/SHELL	TOTAL	TOTAL SOFT 220 ISERV		110s 022	501	000 //	0			Γ
4 PHD SHELL/SERV	AV.	MZ/SHELL	TOTAL m2			Lm2						Γ
	SHELL SIDE C.A. 16"	C.A. 46" / mm	TUBE SIDE C.A.	C.A. 1/8" mm								
o par v		প্ত	7	s <b>5</b>					==			
7 DES PRESS	800 mag		2 450 PSIG	100 m					_			Γ
DES TEMP	S CD 06		<u>.                                    </u>									Γ
PTUBES: DIA	GA MAR	GA MM   AV   WELDED		EXP JOINT								
10 TUBE ENDS: WELDED   NO. TUBES	MELDED   NO	ILI	3	ERECT WI		TONSEA						Γ
11 EA. 105	ATH. TOWER	Q	WER		/				  -			Γ
12 SIZE-IN DAL				1 45U								
13 MO SHELL/SERV. /	RV. /	SO FT/SHELL	TOTAL SQ	SOFT 500 ISERV		500 SOFT	30	15/40	00			
14 MO SHELL/SERV	JY.	m24SHELL	TOTAL m2	m <sup>2</sup> /SERV		m.						
16	SHELL SIDE C.A.	C.A. mm	TUBE SIDE C.A	C.A mm								
16 MAT		62		5								
17 DES PRESS	75 msic/	C	700 PSIC	*da					_			Γ
18 DES TEMP	460 of	9C	650 °F	Э <sub>0</sub>								
19 TUBES: DIA	GA MIN	O AV D WELDED	D C SMLS	EXP JOINT [ ]								
20 TUBE ENDS WELDED   NO TUBES	WELDED   NO		JINSUL [X	ERECT. WT		TONS EA						
21 EA. 106	ATH.	TOWER CON	CONDENCE									
ZZ SIZE IN DAL		4	TYPE	E AEU								
23 NO SHELL/SERV.	AV. /	SO FT/SHELL	TOTAL SO	SOFT 3 SO ISERV		35 S SOFT	-52	9000	2			Γ
20 MO SHELL/SERV	RV.	m <sup>2</sup> /SHELL	TOTAL m <sup>2</sup>	m <sup>2</sup> KERV		m <sup>2</sup>		•				
<u> </u>	SHELL SIDE C.A.	C.A. / mm	TUBE SIDE C.	C.A. / mm								
28 MAT		CS	CS						III			
77 DES PRESS	75 rsig		150 PSIG	hg/cm2								
28 DES TEMP	250 %	) OC	150 °F	၁ <sub>၀</sub>								
29 TUBES DIA	GA MIN	GA MIN AV WELDED	D SMLS []	EXP JOINT []								
30 TUBE ENDS	TUBE ENDS WELDED CINO TUBES		INSUL[]	FRECT WT		TONSEA						
TOTAL THIS PAGE	PAGE											
TOTAL ACCOUNT	JUNT											
CLIENT AP10 CO	10 Co 100E		ANS GASIE	AANZ PROD FACT	C.T	LOC M H		A8	35	C ON BOL	5 7/ ACCT	5
LOCATION	BEULAH	H NORTH	77	MACE BATE		1000 B4		DATE	1/2/2	60	EA .	
rachect ~ t	27 +1.67 +	MUNICIAET FIEL FRONT COAL JEPUTL	7	QU105 11		ווישו בנושו	1	II II	>		,	٦
										ξ.	2 7 41 B Livit C( 14	^ >

N				ESTIMATE SHEET	SHEE	-	!	i			THE LUMB	THE LUMMUS COMPANY Bloomfield	<b>&gt;</b>
					8	DUANTITY	LINO	MATERIAL	וושר	STO	STD LABOR MM	SUBCONTRACT	FACT
_	2680				REO	TOTAL	COST	COST		UNIT	TOTAL	COST	
1 EA 107	FUEL 645	7000	ER		_						_		
2 SIZE-IN DIL	/Q www	۰	TYPE	Darble PIPS							) 		
3 NO SHELL/SERV.	IV. SO FT/SHELL	ELL	TOTAL SOFT	100 ISEAN		100 SOFT		7	000				
4 NO SHELL/SERV	TV. m2/SHELL	يا	TOTAL m2	/SE RV		E.					-		
9	SHELL SIDE C.A.	F	2	- ww									
SKAT.	3		SS										
7 DES PRESS	750 PSIG/	N. Caro	150 PSIG/	hOkem2									
B DES TEMP	300 %	မ	150 of	)OC									
TUBES: DIA	CA MIN O AV	WELDED []	SMLS [] EXP	JOINT []									
O TUBE ENDS: N		Ů		ERFCT WT		TONS EA							
:: EA 10 B	RECYCLE COMPRESSOR	30	CIRCUMTION	857000	1								
12 SIZE IN D/L	1		TYPE &	G									
13 NO SHELL/SERV.	RV. SO FT/SHELL	113	TOTAL SOFT 320	320 ISERV		3205011	3	/3	000				
14 MO SHELL/SERV	RV. m <sup>2</sup> 1SHELL	1	TOTAL m2	/SERV		æ							
٠	SHELL SIDE C.A. 1/8"	THE STATE OF	TUBE SIDE C.A	",6"/ mm							-		
16 MAT	SS		CS										
17 DES PRESS	/So PSIG/	kern?	2500 PSIG	hgirm?									
18 DES TEMP	150 %	oC	320 05	ე <sub>0</sub>									
19 TUBES: DIA	A IMIN O AV	WELDED 🗌	SMLS [] EXP	JOINT []									
20 TUBE ENDS: N	TUBE ENDS WELDED NO TUBES	Ţ	WSUL []	FRECT. WT		TONSEA							
21 EA.													
ZZ SIZE IN DIL	mm D/L	ب	TYPE										
23 NO SHELL/SERV	RV. SOFT/SHELL	פוו	TOTAL SOFT	/SERV		SOFT							
26 NO SHELL/SERV	TA. m3/SHELL	11	TOTAL m2	SERV		m <sup>2</sup>							
25	SHELL SIDE C.A.	men	TUBE SIDE C.A.										
28 MAT													
27 DES PRESS	PSIG/	herem?	PSIG/	hgirm?									
28 DES TEMP	/30	၁	/30	၁၈									
28 TUBES: DIA	CA MIN O AV	WELDED	SMLS[] EXP	Joint []									
30 TUBE ENDS	TUBE ENDS WELDED NO TUBES	Į	ASUL [ ]	FRECT WT		TONSEA							
TOTAL THIS PAGE	PAGE												
TOTAL ACCOUNT	UNT												
CLIENT AP10 CO	10 Co / DOE - GPEAT PLAINS	17.0 14	GASIE	PANZ PROD FACT	-	LOC M H.				25	ON BOT	1255	ACCT
LOCATION	COUNTY SELLAH MORTH	7 77	ALCIA	WAGE RATE	-	LAB COST	+		ш)	-/2	86	-	EA
L > 1 . H ( 11 )			Marin I Tracing	=					\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			-	

Colora Land State   Colo											
Color   Colo	EN SILVANUS			ESTIMATE	SHEE	_			1	THE LUMMU	S COMPANY
Color Lame Superior   Color Legacy   Color Legacy   Color Lame Superior   Color Legacy   Color					8	ANTITY	UNIT	MATERIAL	STD	LABOR MH	SUBCONTRAC
		DESCRIPTI	NO.		REO	TOTAL	COST	COST	CNIT	TOTAL	COST
TOTAL BARE SINE		l			1						
TOTOL Land SINF   FINNED   F	TOTAL BARE SURF	l	2	0		2800 SOFT		0			
TOTAL BATE SUPPLY   TOTAL LAW   TOTAL LA		FINN	ED/	m2FA		m2					
	TUBE MAT C.S.		LENGTH	NO BUNDLES							
Cost nets   450   Field   Cost new   50   Field   Fi		E	LENGTH	ROWS 6							
NOTAL BATE STATES   NOTA		PSIG	MP J	OF TOTAL HP							
TOTAL BASE SUME   FINNED   TOTAL BASE SUME   T		May 2	STEMP	TOTAL							
HERLI   TONS EMAILED	EA/HP	2									
TOTAL BARE SURE   FINNED   F	KNOCK DOWN PREASSEMBI	LED									
TOTAL BARE SURF   FEFTLASY   TOW GR CONDENSER   1	INSUL []			FRECT WT		TONS FA					
TOTAL BARE SURF   FINNED		1	یہ ا	GNSER	_						
TOTAL BARE SURF   FINNED   F	1	1		4		720 50 57	127	0			
TUBE MAT   DIA   IN   LENGTH-NO BLUNDLES   DESTEUR 360 ° F   TOTAL IM**   DESTEUR 360 ° F   DE	TOTAL BARE SURF	FINN	ĮO3			E					
DES PRESS   7   F   F   F   F   F   F   F   F   F	TUBE MAT		LENGTH	NO BUNDLES							
DES PRESS         PSIG         DES TEMP         360 ° F         TOTAL LW         C         TOTAL LW         C         TOTAL LW         C         COTAL LW         C         C         COTAL LW         C		E	LENGTH	ROWS							
NOE FRESS         LANCE OF FAME OF A TEAM         OC TOTAL LWW         OC T		_	3	_							
NO F ANS	DES PRESS	L _ i	STEMP								
FRECT WT   TONSEA	NO FANS DAVE EA HP !	7									
FORECT WIT   SOFTE A   TONNS EA	KNOCK DOWN/PREASSEMBL	ED									
F.C.   FINNED   SOFTE   SOFT	INSUL []					TONS EA					
TOTAL BARE SURF         FINNED         SOFTER         SOFT           TOTAL BARE SURF         FINNED         M2EA         M2           TOTAL BARE SURF         FINNED         M2EA         M2           TOTAL BARE SURF         FINNED         COTAL HIP         COTAL HIP           DOES PRESS         NO FANS         EARTHR         C TOTAL HIP           NO FANS         EARTHR         C TOTAL LW         C TOTAL LW           NO FANS         EARTHR         C TOTAL LW         C TOTAL LW           NO FANS         EARTHR         C TOTAL LW         C TOTAL LW           NO FANS         EARTHR         C TOTAL LW         C TOTAL LW           NOTAL LWS PAGE         TOTAL LW         C TOTAL LW         C TOTAL LW           TOTAL LWS PAGE         TOTAL LW         C TOTAL LW         C PROD FACT         LOC M H           LOCATION         B E C LAM         NO FTH         DA C CTAL         C TOTAL LW         C TOTAL LW <td></td>											
TOTAL BARE SURF         FINNED         m2EA	TOTAL BARE SURF	NNI	<b>(</b> 03	SQFTEA		SOFT					
TUBE MAT         DIA         IN         LENGTHINO BONDLES           CES PRESS         FSIG         DES TEMP         °C         TOTAL HP         COTAL LP         COTAL LP <td></td> <td>FINN</td> <td>E D/</td> <td>m<sup>2</sup>EA</td> <td></td> <td>m<sup>2</sup></td> <td></td> <td></td> <td></td> <td></td> <td></td>		FINN	E D/	m <sup>2</sup> EA		m <sup>2</sup>					
DES PRESS         PSIG         DES TEMP         OF         TOTAL HP         OP         TOTAL LW         OP			LENGTH	Ş							
DES PRESS         FSIG         DES TEMP         OF         TOTAL HP         PROJECT FLAM GASTE. TLAM GASTE		THE .	LENGTH	INO. ROWS							
DES PRESS  Light And CLIENT Amole Cife Carle When the Color of the Carle Wash and the Color of the Carle Wash and the Carle Was	DES PRESS		STEMP								
KNOCK DOWN/PREASSEMBLED INSUL!  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOUS / POE -GREAT FLAIN'S GASIF. PLAIN'S  LOCATION BEOLDAY, VORTH PAKETA  LOCATION BEOLDAY, VORTH PAKETA  PROJECT JET FUEL FRUIL CALL DR 2117 2 1,00 1 DS  MAGE RATE  LAB. COST  REPORTED  TONS EA  TONS			STEMP	_							
NOUL CONNINPREASSEMBLED  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOUND POLE - GREAT FLAMS GASIF. TLAWS  LOCATION BEOLDA, WORTH DAKATA  TOTAL ACCOUNT  CLIENT AMOUND POLE - GREAT PLANS GASIF. TLAWS  TOTAL ACCOUNT  CLIENT AMOUND POLE - GREAT PLANS GASIF. TLAWS  TOTAL ACCOUNT  TOTAL THIS PAGE  TOTAL TOTAL ACCOUNT  TOTAL THIS PAGE  TOTAL TOTAL ACCOUNT  TOTAL THIS PAGE  TOTAL TOTAL ACCOUNT  TOTAL ACCOUNT  TOTAL ACCOUNT  TOTAL THIS PAGE  TOTAL TOTAL ACCOUNT	NO. FANS	MA/									
THIS PAGE  ACCOUNT  ACCOUNT  AMOUND FOR THAT IN THAT I		ונס									
POSE-GREAT FLAMS GASSE. TLAWF PROD FACT LOCMH SOLAH WORTH DAKETA  WELFRIN CALDE REIFF FLOURDS WAGERATE LAB COST REV Z	SINSUL []					TONSEA					
POLE -GREAT FLAINS GAISIF. FLANS  EULAH, NORTH DAKOTA  WAGE HATE  LOC. M.H  BY 655 NOB NO. 5571  LOC. M.H  OATE 2-1-89  EST NO. 5571  TOEL FROM CAL DE 2/11/2 1/00/105  MAGE HATE  LAB. COST	TOTAL THIS PAGE										
FOLE GREAT PLAIN GAISH. TLAINT PROD FACT LOCMH BY 65 NOB NO. 5571  EULAH, NORTH DAKETA  WAGE HATE  LAB. COST  REV 2	TOTAL ACCOUNT										
11.2 LIQUIDS WAGE RATE LAB COST REV 2	1	GREAT FLAM	1. JISH	ANT		LOC. M.H.		BY	- 1	ON BOY	112
11.2 LIQUIDS WAGE MATE LAB. COST REV	LOCATION BEULA,	H, WORTH			+		+	DATE	2-12-2	3	T
	PROJECT JET FUEL F	FRIII CLALL	6.11	=		LAB, COST	 	RFV	2		

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	)					
AR	AREA 100					
ESTIMATE SHEET	SHEET				THE LUMMU	THE LUMMUS COMPANY Bloomfield
DESCRIPTION	UANTI	UNIT	MATERIAL	loh	LABOR MH	
1FA-101 FEED SURGE DRUM	REG EA	3	<u>-</u>	TIN)	TOTAL	COST
1	1000	2 281	000			
3 m   mm	X					
AMAT C S CLAD LINING CA 1/4" / mm						
75 PSIG DESTEMP 300			-			
horm DES TEMP						
7 X-RAY-SPOT [] 100% [] STRESS REL [] FAB SHOP [] FIELD []						
DINTERNALS VOETEX BREAKER						
10 INSUL IN HORIZ   VERT IN SPHERE	TONS		-			
HOT HP SEPARATOR	\					
31.0" 10 10	70.000 LBS	- 1632 S	7000			
13 mCmm		_	1			
14 MAT 21/Cr - / MO CLAD SLINING CA						
15 DES PRESS 2500 PSIG DES TEMP 800 OF						
16 DES PRESS LEMP OC						
17 X RAY-SPOT [] 100% [ STRESS REL [] FAB SHOP [ ] FIELD []						
18 INTERNALS:						
INSUL EL HORIZ CO VE	TONS					
FA 103 HOT LP	/					
3-6" ib 9	5000 185	5-	25 500			
ı						
MAT / CT //2 HO CLAD BLINING CA						
450 PSIG DESTEMP 800						
27 X.RAY.SPOT   100%   STRESS REL   FAB.SHOP   FIELD						
20 INTERNALS:						
30 INSUL DE HORIZ O VERT DE SHPERE O	TONS					
TOTAL THIS PAGE						
CLIENT AMOCO JOUE - GREAT PLAINS GASIF PLANT PROD FACT	LOC. M.H.	<b>.</b>	BY	55	S ON BOY	S 7/ ACCT
LOCATION SEULAH, NORTH DAKOTA				68/1212	LSI .	FA
MOJECT JET FUEL FROM COAL DEPIVED LIQUIDS WAGE RATE	LAB. COST	3.1	RFV.	2		

DESCRIPTION  FA. 10 \$ INTERM. LP 3 E PARR  3 - 6" 10   1 -0" TT  MAT CS (32) CLAD [LINING]  DES PRESS  WAAV-SPOT [1004 [] STRESS REL [] FAB SH  INTERNALS  WAT CS (38) CLAD [LINING]  FA. 10 \$ COLD LP \$ E PARR PT  FA. 10 \$ COLD LP \$ E PARR PT  MAT CS (38) CLAD [LINING]  DES PRESS  X RAV-SPOT [1004 [] STRESS REL [] FAB SH  INTERNALS  INTERNALS  INTERNALS  X RAV-SPOT [1004 [] STRESS REL [] FAB SH  INTERNALS  INTERNALS  X RAV-SPOT [1004 [] STRESS REL [] FAB SH  INSUL [S] HORIZ [S] VERT [] SHERE []  DES PRESS  X RAV-SPOT [1004 [] STRESS REL [] FAB SH  INSUL [S] HORIZ [] VERT [S] SHFRE []  INTERNALS  INTERNALS  YORL ACCOUNT  CLIENT MYOCO/DDE \$ EBCHT PANAS  LOCATION & BEULLAN, NOPPH DAN  FROJECT VET FUEL, FROH CANA									THE LIBERT	300000	[3
CONTINUE	Cost		SHEET				:		Bio	omfield	
	1		No.	NTITY	TINO	MATER	ואר וואר	I۵۲	LABOR MH	SUBCONT	HACT
	3 - 6 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7	4	MEO.	EA			+		101AL	3	
		2''' L' SETANDA	+		1	+-	+	1		+	
NATE   C S (	NET   C S ( S C C C C C C C C C C C C C C C C					+	8				
		MAT CC (3P) CLAD LINING CA 1/4"									
NEST   Control	SERVING   1000   STREES REL   FARS SHOP   FIELD	DES PRESS 450 PSIG DES TEMP 600									
NEWLECON   1000   19THES REL   1-6   10   10   10   10   10   10   10   1	NEWLEXT   1000	Apr. DESTEMP	-								
HEBUL & HORIZ   VERT & SHERE     FRECT NT   TONS   TONS	INSULE   HOUR   SPRENC   TONS   TONS										
FALIST   HORIZ   VERT   SHERE   FALIST   TONS   FALIST   TON	FALL IS   HORIZ   VERT   SPREE   FRICT   WT   TAX   SKRITH   TAX										
NOBLICE   NOBL	HORLI & HORLI   HORL										
Color Old Charles   Colo	C	VENT (S) SPHERE		TONS							
	Color   Colo	COLD LP	-	,			-				
MAT   C.S. (S.R.) CLAD   LINING   CA ' / 4 "	MATERIAL   C.S. S.R. CLAD   LINING   CA. 1/4"	6-0" 10 18-0" TT TK SKIRT		$\sim$		00					
MAT   C.S. /SR	MAT   C.S. / SR   CLAD   LINING   C.A.   19   1	uu Du									
DES PRESS   450   PSIG   DES TEMP   200 °F	DES FRESS   450   PSIG   DIS TEMP   OCA	MAT CS (SR) CLAD LINING CA 1/4"									
NEST   CONTRIBUTE   CONTRIBUTE   CONTRIBUTION   CONTRIBUTE   CONTRIBUTION   CON	NET   NOTE   N	450 PSIG DESTEMP 200									
NATERIALS   NOTES REL     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE   TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE     TABLE   TABLE     TABLE     TABLE   TABLE     TABLE   T	NATION   CONTINUED   CONTINU	Parent DESTEMP									
NESTRALS   MIST	NEUL □ HORIZ Ø VERT □ SHERE □  2 - 6" 10 8 - 0" TT TK SKIRTHT   1500   1500   1000    2 - 6" 10 8 - 0" TT TK SKIRTHT   1500   1800   1800   1800   1800   1800    10 - 10 - 10 - 10 - 10 - 10 - 10 - 10	X RAY-SPOT [] 100% STRESS REL [] FAB SHOP									
NEUL   HORIZ   VERT   SHERE   FRECT WT   TAX   SKIRT HT   1   1   1   1   1   1   1   1   1	FA   10   H   10   10   10   10   10   10	INTERNALS HIST ELIMINATOR VORTEX									
INSUL   HORIZ & VERT   SHERE   FRECT WT   TK SKHITHT   1/5 LBS 3 - 4/5 CO	INSUL   HORIZ & VERT   SHERE   FRECT WT   TK SKIRT HT   1/5 CL 188   3 - 4/5 CD	- 1	1					-+	-		
1	1	SPHERE [] FRECT	-	TONS				1			
2'-6" 10 8'-0" TT TK SKIRTHT   /500 LBS 3'- \$\sqrt{500}   mathematical Components   1500 Liming   1500 LBS   3'- \$\sqrt{500}   mathematical Components   1500 Liming   1500 LBS TEMP   0'c    NY FRAY SPOT   100%   STRESS REL   FAB SHOP   FIELD      NY FRAY SPOT   100%   STRESS REL   FAB SHOP   FIELD      NY FRAY SPOT   100%   STRESS REL   FAB SHOP   FIELD      NY FRAY SPOT   100%   STRESS REL   FAB SHOP   FIELD      NY FRAY SPOT   100%   STRESS REL   FAB SHOP   FIELD      NY FRAY SPOT   100%   STRESS REL   FAB SHOP   FIELD      NY FRAY SPOT   100%   STRESS REL   FAB SHOP   FIELD      NY FRAY SPOT   100%   STRESS REL   FAB SHOP   FACT   100 M H      NY FRAY SPOT   100%   STRESS REL   100 M H      NY FRAY SPOT   100%	2/-6" 10 8'-0" TT TK SKIRTHT /50 LBS 3- 4500  minimum  MAT  CS CLAD □LINING□CA 1/4"  DES MESS  DES MESS  A. PORT EX B. C   STEWP 625 or    NY MAY SPOT □ 100M □ STREES REL □ FIELD □  INSUL SHORTS   SHPERE □    NY MAY SPOT □ 100M □ STREES REL □ FIELD □  INTERNALS   VOR TEX B. SHPERE □    NY MAY SPOT □ 100M □ STREES REL □ FIELD □  INSUL SHORTS   VOR TEX B. SHPERE □    NY MAY SPOT □ 100M	FA: 106 HVGO	_				+				
Mat	MAT   CS   CLAD   LINING   CA   14   1	2'-6" ID 8'-0" TT TK SKIRT		3		-4					
DES PRESS  DES PRESS  DES PRESS  DES PRESS  NUMBERS  NUMBERS  NAMERNALS  NORTHENALS  LOCATION & CARL ARANS & FSTF. MANT  PROJECT JOST FLOCK ARANS  P	MAT         CS         CLAD □LINING □ CA 1/4"         mm         m										
DES PRESS         7 S & FV         PSIG         DES TEMP         OC         OC           Libraria DES TEMP         OC	DES PRESS  DES PRESS  X. RAY-SPOT □ 100% □ STREES REL □ FAB. SHOP □ FIEL □ □  INTERNALS VOR TEX BEGAKER  INSUL ® HORIZ □ VERT ® SUPERE □  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOCO/DOE & REAT PLANT   PROD FACT   LOC MH  TOCATION & REV. A. V. O. P.T. J. J. P.P. J. J. J. J. J. J. J. P.P. J.	MAT CS CLAD LINING CA 1/4"									
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N. RAY-SPOT DIOM STRESS REL FABSHOP FIELD DEFINED TO THE PAGE  INTERNALS VORTEX BAPERE DEFINED TO THE PROPERTY TOWNS  CLIENT MATOCO VOE GREAT PLAIS GAST. PLANT PRODERCT LOCK MH.  CLIENT MATOCO VOE GREAT PLAIS GAST. PLANT PRODERCT LOCK MH.  CLIENT MATOCO VOE GREAT PLAIS GAST. PLANT PRODERCT LOCK MH.  FROJECT JET FLEL FROM CAMAL ACRIVED LIBRIDS WAGERATE LAB COST REV. 2.	N. MACENIALS: VORTEX BREAKER  INSUL SHORIZ   VERT SHERE   FABSHOP   FIELD    INSUL SHORIZ   FABSHOP   FABSHOP   FABSHOP    INSUL SHORIZ   FABSHOP    INSUL SHORIZ   FABSHOP   FABSHOP    INSUL SHORIZ    INSUL SHORIZ	NP N									
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INSUL ® HORIZ USERT B SHPERE USER ERECT WT TONS  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT MYOCO/DDE GEGAT PLAIS GASF. PLANT  LOCATION BEULGAM, WORTH DAKOTH  HOLE TOTAL THE COST ACT ACT ACT ACT ACT ACT ACT ACT ACT AC	INSUL ® HORIZ ☐ VERT ® SHPERE ☐  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT MYCOC/DDE GEGAT PAINS GASA / AM  LOCATION BEULAM, WORTH DAKOTH  PROJECT JET FLEL FROM COAL NERVINS WAGERATE  TOTAL TOOLS  TOTAL TOOLS  TOTAL TOOLS  TOTAL TOOLS  TOTAL THOSE OF THE SHPERE ☐  TOTAL TOOLS  TOTAL TOOLS	INTERNALS VORTEY									
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DEAT PLAIS 6 FSF. PLANT PROD FACT LOC MH. BY 65 JOB NO. 557/ WORTH DAKOTH FROM COML DERIVED LIAVING WAGERATE LAB COST REV. 2	PEAT ALALYS & ASIF. PLANT PROD FACT LOC MH. BY GS JOB NO. 557/ WORTH DAKOTH WAGE RATE LAB COST REV. 2.	TOTAL ACCOUNT	_								
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ESTIMATE SHEET  SESCIENTON  FA. 107  LVG O ACCUMULATOR  LOSS TO BE SECURITION  FA. 107  LVG O ACCUMULATOR  LOSS TO BESS TO BES	CS CLAD CHAINED   CN ON THE LUMBRIS   CN ON ANTITY   CN ON ATTENDED   CN ON ANTITY   CN ON ATTENDED   CN O	AA	AREA 100					
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STATE   STA	STATE   STAT	CS CLAD [LINING ] CA : 1/4" /						
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NHERMALS VORTECK À REALLEC  NHERMALS VORTECK À REALLEC  INSUID HOUR DISTRESS REL DEABHOR LIFELO D  FA. 10B VACUUM HOTTHELL TR SKINTHT 7000 LBS 3 2/000  AND THE CS CLAD LIMING DAY 1/4" mm  MAT CS CLAD LIMING DAY 1/4" mod 5 mm  MAT CS CLAD LIMING DAY 1/4" mod 5 mm  MAT CS CLAD LIMING DAY 1/4" mod 5 mm  MAT CAN 1/4" MAT 1/4" MAT 1/4" MAT 1/4" mod 5 mm  MAT MAT MAT MAT 1/4" MAT 1/4	STAND SOUT   TOWN   STREES REL   STAND SOUT   STAND SOU	NAT DES TEMP						
	INTERNALS   VORTEX   SPERIC   SPERIC   TONS	X-RAY-SPOT   100%   STRESS REL   FAB-SHOP						
TONS   CONTROL OF STREET   TONS   TONS	The column   The	INTERNALS: VORTEX						
FALLOS   VADUCH   H-CTLACL   TX   SKIRT HT   T   T   T   T   T   T   T   T   T	The color   Very B sphere   The color							
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MAT   C.S   CLAD   LINING   C.S   Teap   C.S	MATERIALIS   C.S. CLAD   LINNING   C.S. 1/4"	3-6" 10 12 TK SKIRT		N				
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DES PRESS  X RANY SPOT   100M   STRESS REL	DES FRESS  XAAY-STOT   100M   DITE	MAT CS CLAD LINING CA 1/4"						
NEBNALS: BAFELE, VOETER BREAKER, BARCHETRIC	NETENAL STATE   100%   STRESS REL   FAB SHOP   FIELO	75 & FV PSIG DES TEMP						
MYTERNALS: BAFFLE, VORTEX GREAKCE, GARCHETRIC LAGS  LA	MATERIALS: BAFFLE, VORTEX GREAKCE, BARCOMETRIC  LAGS	DES PRESS Apert DES TEMP						
HERLIC HORIZ & VERTEX BREAMER, BARCMETRIC  LEGS  LIEST  LEGS  HISBUL   HORIZ & VERTE   SHERE   ERECT. WT  St. 109 ATTH. TD WER SUPERCONT  St. 009 ATTH. TD WER SUPERCONT  MISSUL   HORIZ   LOC. MH  HORIZ   LIENT ANNORMY DAY, PLANT   PROD FACT   LOC. MH  ST. 000 ATTH. TD WER SUPERCONT  WAGGRAGE  100 ATTH. TD WER SUPERCONT  TOTAL THIS PAGE  100 ATTH. TONS  TOTAL THIS PAGE  TO	MYTERNALS: BAFFLE, VORTEX BREAKER, BARCMETRIC   Leg S	X.RAY.SPOT 11008 STRESS REL FABSHOP						
FA   109   ATH   TD   LOVE   SURGE DE UM   TR   SKIRT HT   AGOLD 188   \$\frac{1}{2} \rightarrow \text{   TO   LOVE   SURGE DE UM   TK   SKIRT HT   AGOLD 188   \$\frac{1}{2} \rightarrow \text{   TO   LINING   CA   \frac{1}{2} \rightarrow \text{   LINING   \frac{1}{2} \rightarrow    LINING   \frac	FA   109   ATM   TD WER   SURE     FRECT WT   TONS   FA   109   ATM   TD WER   SURE   ERECT WT   TONS   FA   109   ATM   TD WER   SURE   ERECT WT   TONS   FILE   ERECT WT   TONS   FILE   ERECT WT   TONS	BAFFLE, VORTEX BREAKER.						
FA   109	FA   109	5997			_		-	
## 109 ATM: TD WER_ \$\(\overline{\mathbb{O}}\) \(\overline{\mathbb{O}}\) \(\overline{\mathbb{O}	## 109 PTM: TD WER SURGE DRUM    State   109 PTM: TD WER SURGE DRUM   State   12 1 - 0   TT   TK   SKARTHI   1		TONS		-			
S   -O"   10   12   -O"   TT   TK   SKIRT HT   A   A   A   A   A   A   A   A   A	S   -O"   10   12   -O"   T   TK   SKIRT HT   40   ->   ->   ->   ->   ->   ->   ->   -	FA 109 ATH TO WER SURGI	,		_			
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DESPRESS  X. RAY SPOT DIOON DITRESS REL DEAL FIELD TELLO TEL	DES PRESS  X. RAY SPOT   100%   STRESS REL   FAB.SHOP   FIELD    INSUL   HORIZ   VENT & SHPERE    TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT APPLICACY   2006 - GREAT PLAIN'S GASIF. PLANT    INCLIENT APPLICACY   2006 - GREAT PLANT    INCLIENT APPLICACY   2006 - GREAT PLANT    INCLIENT APPLICACY   2006 - GREAT    INCLIENT APPLICACY	DES PRESS 75 PSIG DES TEMP 300			-			
MITERNALS:  INSUL CHORIZ OF VERT SHERE CHORIS ERECT. WT  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMUCO DOE - GREAT PLAINS GASIF, PLANT  FROD FACT  LOCATION BE-ULAH NURTH DAY OF A DE SILVER D	NYTERNALS:  INTERNALS:  INTERNALS:  INSUL   HORIZ   VERT   SHPERE    TOTAL THIS PAGE  TOTAL	DES PRESS LPEMP			-			
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TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOLO DOE - GREAT PLAINS GASIF, PLAIN   PRIOD FACT   LOC. M.H.   BY & S   LOB NO. 5571    LOCATION BE ULAH NURTH DAYOFT   DAYOF	TOTAL THIS PAGE  TOTAL						-	
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DOE-GREAT PLAIN'S GASIF, PLAINT PROD FACT LOC.M.H. BOY & S DOB NO. 5571	DOE-GREAT PLAINS GASIF, PLAINT PROD FACT LOC.M.H. BY & S LOB NO. 5571  EL FROIN COAL DELIVED LIQUIDS WAGERATE LAB. COST REV. 1  A122 1991.18	INSUL   HORIZ   VERT   SHPERE	TONS					
JOOE-GREAT PLAINS GASIF, PLAINT PRIOD FACT LOC. M.H. BY & S LOB NO. 5571 ELUCAH, NURTH DAYOTA WAGERATE LAB COST REV. 1	COLAH, NURTH DAYOTA  EUEL FROM COAL DEXIVED LIQUIDS WAGERATE  LAB COST  LAB COST  LAB COST  LAB COST  REV 1  A172 1991				-			
DOG-GREAT PLAINS GASIF. PLANT PROD FACT LOC.M.H. BY 65 NOB NO. 5571	DOE-GREAT PLAINS GASIF, PLANT PROD FACT LOC.M.H. BY 65 S NOB NO. 5571  SULAH, NURTH DAYOTA  UEC FROM COAL DEKIVYO LIQUIDS WAGERATE LAB. COST REV. 1  A122 19919	TOTAL ACCOUNT			-		4	
DAKOTA DE JULY DI JANJAC WAGERATE LAB COST REV /	DAKOTA DEKIVED LIQUIDS WAGERATE LAB. COST REV. 1	DOE-GREAT PLAINS GASIF, PLANT			۵	65	LEST NO.	112
		DAKOTA DEVINO LIQUIDE			DATE	(A) (TZ)		<b>*</b>

DESCRIPTION  TALL NORTH SHERE CLAD CLINING CA 1/9"  TOTAL COLON TO 8 - O" TT TO TO 8 - O" TT TO 1/9"  TOTAL COLON TO STREES REL   FABSHOP   FIELD    TOTAL COLONT   100%   100%   100%   100%   100%    TOTAL COLONT   100%   100%   100%   100%   100%    TOTAL COLONT   100%   100%   100%   100%   100%    TOTAL COLONT   100%   100%   100%   100%   100%   100%   100%   100%    TOTAL COLONT   100%   10	l						ことではいついる
A		SHEET				<b>B</b> 100	mineld
		QUANTITY	LINO	MATERIAL		LABOR MH	SUBCONTRAC
			COST	соѕт	Н	TOTAL	COST
2.1 6"   0   \$\frac{2}{4} \cdot 0   \$\frac{4}{4} \cdot 0   \$\frac	ATH. TOWER OVH'D ACCUMULA	,					
	ID \$'-O" IT TK SKIRT	100//		M	0	-	
			=		=		
State   Stat	CS CLAD THINING CA 1/4"						
STAN 1907   1000   STRESS REL     1	75 PSIG DES TEMP 250						
NHITINGALS VOZTEX GREANER, NATOR POT  NHITINGALS  NHI	10cm DES TEMP						
HERLING   HORIZE   VETTEX GREAKER   MATER POT	ப						
TOWN INCOLUMN INCOL	INTERNALS VORTEX						
NESUL   HORIZ   VERT   SHERE   TOWN							
	HORIZ K VERT SPHERE	TON	5				
	WATER WASH JURGE DR	,					
MAT   C S   CLAD   LINING   CA   /4	41.6" 10 11.0 TT TK	ו			0		
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NITERNALS:  INTERNALS:  INTERNALS:  INSUE ME HORIZ   VERT ES REL     FAB SHOP	150 PSIG DESTEMP 400						
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INTERNALS:   INT	X RAY SPOT [] 100% STRESS REL [] FAB SHOP []						
FA   12	INTERNALS:						
INSUL     HORIZ   VERT     SPHERE     ERECT WT   TAX   SKIRT HT							
124"   00   5'-0"   TT   TK   SKIRTHT	INSUL IN HORIZ U VERT IN SPHERE	TON	S				
24" 00 5"-0" TT TK SKIRTHT / COO LBS 4/ 4000  MAT C.S. CLAD □LINING□CA /4" mm  MAT C.S. CLAD □CA /4" mm  MAT C.S. CLA	FA 1/2 WATER SEAL						
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MAT         C.S         CLAD □LINING □ CA	m 🗌 mm				-		-
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INTERNALS.  INSUL   HORIZ   VERT   SAPERE    TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT ANY LOCATION   BE-ULAH AURTH   DAY OTA    LOCATION   BE-ULAH AURTH	DES PRESS NPC						
INSUL   HORIZ   VERT B SHPERE   ERECT WT TONS TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT ANY LOCATION BE ULAN ANSTH DAY OTA MAGENATE LAB COST REV.	X-RAY-SPOT 100% STRESS REL TEAS-SHOP		-		+	-	-
TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL CHIS PAGE  TOTAL ACCOUNT  CLIENT ANY OLD STATE PLAINT GASIF. PLAINT PRODEFACT LOC M.H. BY \$5 AND NO. 5571  LOCATION BE-ULAH AURTH DAYOFT HOND WAGE HATE LAB. COST REV.   1 AND STATE PLAINT PRODUCT TET ELIFT FOR THE PAGE PAGE  TOTAL THIS PA			+	+	+		
TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT ANI/LOCO / DOE - GREAT PLAIN'S GASTE, PLAIN'S PRODEFACT  LOCATION BE-ULAH AURTH DAYOTH PRINCES WAGE HATE  LOCATION BE-ULAH AURTH PRINCES WAGE WAGE HATE  LOCATION BE-ULAH AURTH PRINCES WAGE WAGE WAGE WAGE WAGE WAGE WAGE WAGE					+		+
DOE-GREAT PLAINS GASIF, PLAINT PROD FACT LOC MH. BY 45 JOB NO 5571	INSUL   HORIZ   VERT   SHPERE	TO	S	1	+	+	
GULAH WURTH DAYATA MAGENATE LOC MH BY 55 108 NO. 5571	TOTAL THIS PAGE		+	1			-
MY GASIF. PLAINT PROD FACT LOC M.H. BY 45 JOB NO. 5571  DA LOT A  DE 2/1/P9 EST NO. 5571  REV.			-	+		T	
DALGTA  DE 2/11/27  NAGE HATE  LAB. COST  REV	DOE-GREAT PLAINS GASIF. PLANT		<u> </u>	<u>à</u>	5	100 TO	115
	BEUCAH WORTH DAKOTA		752	<b>V</b>	7/11/2		4

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1			8	ANTITY	LIND	MATERI	۲	STD LABOR		SUBCONT	Ş
			REO	EA	COST	COST	<u></u>	_	۶	COST	
18" OD 3. C	FA 113 NATER COLLECTION		`				-	L			
NATIONAL CLAD CHANGE CA. 1/4"   monoisments  OES MESS  OES MESS  T.S. FRIG.   GES TEAM 300 °°° °°  OES MESS  T.S. FRIG.   GES TEAM 300 °°° °°  NETHONALS	11 40 -/€ ab 48/	SKIRT HT		/OOC 185	4		8				
	m Dmm D										
STAND   STREET   ST	MAT CS CLAD LINING CA 1						=				
STATE   STAT	DES PRESS 75 PSIG	300									
HIGH NATE   HORIZ   VERT   SPERE   HORIZ   HORIZ   HORIZ   HORIZ   HORIZ   VERT   SPERE   HORIZ   HORIZ   HORIZ   VERT   SPERE   HORIZ   HOR	hp. specimen hp. s										
HISTORIAL S											
FA   14   FORE   GAS   W.O. DRUPY   TK   SKIRT HT   ZOOD LBS   4   ROOD											
TOWN CONTROL   STATE											
1	INSUL IS HORIZ   VERT [	ERECT. WT		TONS							
2 - € " 10	114 FUEL GAS K.O. DE		/ / ]								
	11 8-0, II	SKIRT HT		l i	4		7			-	
DES PRESS   350   PSIG   DES TEMP   50 ° F											
DES PRESS  DES FRESS	MAT CS CLAD [] LINING [] CA	reserve									
NETENT   STATES   NETENT   STATES   NETENT	350 PSIG										-
NHTERNALS: MIST CLAN (ALAPOR)  NHTERNALS: MIST CLAN (ALAPOR)  12. € 10 8 4 6 5 0 1	hpe horema										
INSUL   HONIZ   VERTÉS SHERE   ERECT.WT   TONS   TONS											
FAL     C	INTERNALS: MIST GUMINA										
SKINT   HONIZ   VERT LOS SHERE   FAC. WT   TK   SKINT HT							+				T
State   Stat	INSUL HORIZ VERTIN SPHERE	ERECT. WT		TONS			+	-		1	7
### 25 6 ID 81-0" IT TK SKIRTHI	FA 115 RECYCLE GAS K.		-				+	+			
MAT   CS   CLAD   LIMING   CA   1/4"	2'-6' 10 8'-0' TT	SKIRT HT		8	4	4	8	_			1
MAT         C.S. CLAD   LINING   CA. 1/4"   mm	m Dmm						-				
DES PRESS  LICENT AND COLONAL OF STEAMS  LOCATION BEVLAH, NORTH DAKOTA DERIVED A STEAMS  DES PRESS  LICENT AND COLONAL OF TOTAL THIS PAGE  TOTAL THIS PAGE  LOCATION BEVLAH, NORTH DAKOTA  TOTAL THIS PAGE  TOTA	CS CLAD CLINING CA	ee.					=				
NESPIESS  N. FRANCES FOR CALL DE SIVE DE LEGIO  INTERNALS: MIST ELL FABSHOP   FIELD    INTERNALS: MIST ELL FABSHOP    INTERNALS: MIST ELL FABSHOP	SO PSIG	150					_				
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TOTAL THIS PAGE  TOTAL											
DOG-GREAT PLAIN'S GASIF, PLANT PROD FACT LOC.M.H. BY GS LOB NO. 5571  SULAH, NORTH DAKOTA  UEL FROM COAL DERIVED LIQUIDS WAGERATE LAB. COST REV 1	MSUL   HORIZ   VERT	ERECT. WT.		TONS							
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-GREAT PLAINT GASIF. PLAINT PROD FACT LOC.M.H. BY GS JOB NO. 5571  H. NORTH DAKOTA FROM COAL DERIVED LIQUIDS WAGERATE LAB. COST REV. 1	TOTAL ACCOUNT										
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SUBCONTRACT COST ACCT FA THE LUMMUS COMPANY 1155 Bloomfield JOB NO EST NO STO LABOR MH TOTAL 25 DATE 3/6 /89 TIN5 000 AFV. MATERIAL COST Ą 12 COST 300018S LBS LAB COST LBS TONS TONS LOC, M.H. TONS ¥ QUANTITY **ESTIMATE SHEET** REO MOJECT JET FUEL FROM COAL DERIVED LIGITIDS WARE HATE PROD FACT E 0 E u E SKIRT HT ERECT, WT ပ SKIRT HT ပူ SKIRT HT 9 ပ ERECT WT ERECT. WT. OUGEHEAD DRUM PSIG DESTENP 300 PSIG DESTEMP April DES TEMP DES PRESS

\*\*PAY-SPOT | 100% | STRESS REL | FABSHOP | FIELD | DES TEMP CLIENT AMOCO / DOE - GREAT PLAINS GASIF. PLANT X-RAY-SPOT | 100% | STRESS REL | FAB-SHOP | FIELD | X.RAY.SPOT | 100% | STRESS REL | FAB.SHOP | FIELD | 118/1 ¥ ¥ Sig Value Bleaker CLAD [] LINING [] CA CLAD CLINING CA POWER CLAD [] LINING [] CA DESCRIPTION F INSUL | HORIZ | VERT (3) SPHERE | 9-0" 11 F INSUL | HORIZ | VERT | SHPERE | INSUL | HORIZ | VERT | SPHERE | 25 PREFLASH 6, 6 0 9 CS TOTAL THIS PAGE TOTAL ACCOUNT INTERNALS INTERNALS INTERNALS. DES PRESS DES PRESS DES PRESS - manual Dar DES PRESS DES PRESS MAT MAT MAT

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INSUL BY  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT ANIMOLO / DOE - GREAT PLAIMS GASIF. PLAIM PROD FACT  LOCATION BEULAH, AJORTH AAK OTA  TOCATION BEULAH  TOCA	TYPE CENT -[2]	RECIP   PROP						$\vdash$								
TOTAL THIS PAGE  TOTAL	29 MECH SEAL															
HISPAGE CCOUNT HIDOCO/DOE-GREAT PLAIMS GASIF. PLAIM PROD FACT IN BEULAH , NORTH DAK 67A IN BEULAH , NORTH DAK 67A IN BEULAH , NORTH DERIVEY LAUIDS WAGERATE LAB. COST REV. 1	30 INSUL 🔯			ER	IECT. WT. PU	IMP & DRI	VER		TONS							
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PROD. FACT LOC. M.H. BY (25 108 NO. WAGE RATE LAB. COST REV. /	TOTAL ACCOUNT							$\dashv$								
WAGE RATE LAB. COST REV.	CLIENT AILOC	O/DOE-GRE	AT P4	AWK S	ASIF PL	_	D. FACT		LOC. M.H.			λG	ध	9		
	PROJECT TET	FUEL FROM	ZIZI L	JAKO!	7. 1. M. 1.		3E RATE		LAB. COST	-			7	_,		T
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						AREK 100	00						
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State   Cost			DESCRIPTION			õ	ANTITY	TINO	744	-		8100	whete
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Suct   Page   Erect. WT. Plume & Driver   Tons	EQ. SEAL			1	+	$\dagger$			_	=	L		+
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Or   FT   100   FT   100   FT	€.	SUCT	Per DISCH	NPa TER		+							+
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ALD RECIPE FROM DYNER DATE AND THE STAND FACT  TOWN  T		7	E	9	200	$\dagger$	+	1					+
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41 Decology Count   Effect wt pump & Daiver   Tons   Tons    411/00.0/DE-GREAT PLAINS GASIF PLAIN PROD FACT   LOC MH   80	$\neg$	COP S PROP	OTHERS	AMCI		+	+	1					+
HIS PAGE CCOUNT HIS COLOURS  WE BE CLICK A LOCAL DE CITY OF LAW PROD FACT  WE BE CLICK A LOCAL DE CITY OF LAW PROD FACT  WE BE CLICK A LOCAL DE CITY OF LAW PROD FACT  WAGE RATE  LAN COST  LAN COST	۸t 🗖				+	+	#						+
AUS GASIF PLANT MODERACT LOCIMH BY 65 108 NO. 5571	 ໜີ.		ERECT		Daive	+						+	+
AMIS GASIF PLANT MODERACT LOC.MH BY 65 108 NO. 5571	TAL THIS PAGE					+	TONS					1	+
299 KCTA MAGENATE LOCIMH BY 65 NOB NO. 5571	TAL ACCOUNT				+	+					$\prod$	1	+
DECIVED LAWING WAGE RATE LAB COST DATE 2/21/09 EST NO. 557/	TENT 4/1/000	DE-5/10	ابر ا		1000	f L		1	7				
DECTIVED LATURAL MAGERIATE LAB COST DATE 2/21/05 CSI	CATION DEC.	40H 1 1/0.	とろ		THE PARTY		LOC M.H		١	53	\$	2	Ľ
	WELL JET FU	EL FROM	22	Minte	WAGE BATE		LAB COST		OATE				T

				•	AREX	100							
The summer	MUS			ESTIMATE SHEET	SHEE	-					THE LUMN	THE LUMMUS COMPANY	INV
		TO COMPANY			9	QUANTITY	UNIT	MATERIAL	MAR.	STO	STD LABOR MH	SUBCONTRAC	TRACT
		DESCRIPTION			REC	EA	COST	COST	:T	UNIT	TOTAL	88	Ŀ
1 GA. 107 A ATTY. TOWARE	POWER	C, NAO			7						<u> </u>	L	
2 GPM 10	SUCT	PSIG DISCH		TEMP/LO OF				51	000				
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A SP.GA	٥٥	<u>.</u>	100 651	STGS							_	_	
•	\$0	E	hPe.	HPM									
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D TYPE CENT - ED R	RECIP   PROP	NOP   OTHERS	API 🗌 ANSI										
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HE MAT CASE	11-13 Cr	Cr IMPELLER 1/4/3	১	I MP.									
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18 TYPE CENT -   RI	RECIP ES PR	PROF   OTHERS	API - ANSI	)									
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21 GA-109 110 & 111		REACTOR DE	SECYCLE (30	3 of Ge.)	3								
77 CPM 2.800	SUCT	PSIG DISCH	25	TEMP850 OF				280	1000				
73 m <sup>3</sup> /h	SUCT	HOSIQ PARTY	herena TENN	DO OF									
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TO MECH. SEAL TO TE	TONGSTEN CARB.	- 198	CIAL VERTICAL	CAL								_	
			ERECT. WT. PUN	WT. PUMP & DRIVER		TONS							
TOTAL THIS PAGE											-		
TOTAL ACCOUNT													
CLIENT AUVOCC	10ce-c	21	GASIF. PUN	PROD FACT	71	LOC. M.H.			ΑĐ	65	JOB NO.	5571	ACCT
LOCATION BEULAH	1777	NORTH CAKETA	57A		+		+		DATE	12/2	(2) (2)		<b>₹</b>
PROJECT JET F	VEC FR	MONECT JET FUEL FROM COAL DERINFO LAWIN	IVED LAUN	MAGE HATE		LAB. COST	_		REV.			1	

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	<b>SCS</b>			ESTIMATE SHEET	SHEET	•				_	THE LUMMUS COMPANY Bloomfield	Bloomfield	▶
					हे	DUANTITY	UNIT	MATERIAL	¥.	STOLA	LABOR MH	SUBCONTRAC	¥ C
	Š	DESCRIPTION	_		REO	EA	COST	COST		UNIT	TOTAL	COST	
GA 112 A/S	WASA	WATER			7			_					
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	ı	1							-	-	-		
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TORIVE EM - IS TURE	MB () DIESEL ()	🗆 отнея 🗅		kW.									
20 TYPE CENT - 10 M	RECIP   PROP	] OTHERS□	API - ANSI	J									
MECH. SEAL									=	_			
30 INSUL []			ERECT WT. PUMP &	AP & DRIVER		TONS							
TOTAL THIS PAGE													
TOTAL ACCOUNT				~									
CLIENT AMOCO/DOE-GREAT PLA	100E-5RE	AT PLAWS	WS GASIF PLHE	PROD FACT	-	LOC WH		===	87	88	ON BOT	, 1635	ACCT
LOCATION BEULAH, NORTH	160H 100	RTH CAKOTA	67A		1	LAB COST	-		DATE Z/	11/0		1	₹
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Control   Cont					₹	AA 100	00							
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15		MUS			ESTIMATE.	311				F			1300mfield	
		ž	MOLLANDA			हे	ANTITY	UNIT	MATER	٠ ١٧	E			NTRACT
						REO	EA	1803	3		ž.	107AL	۱ ۱	<u> </u>
3   5   SUCT   FISTED   FISTED   STOCK	1GA 115 A/S	PEERLASH	3	OVEREAD		7							-	1
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### CASE   APP   FT   PSI   STGS   STGS   ####################################	13 m <sup>3</sup> /h	SUCT	Pacm DISCH	borm? TE										-
ADF	16 SP.GR	00	FT	PSI	STGS									-
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GPM         SUCT         FSIG         TEMP         OF           m³A         SUCT         Note and	ZI GA												-	
### SUCT	22 GPM	SUCT		PSI TE										
9-GR	13 m 3 m	SUCT		Agrems TE										
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MAT: CASE ORIVE EM — ☐ TUNB ☐ DIESEL ☐ OTHER ☐ NY  WECH. SEAL ☐  WAGE RATE ☐	£	70	E	kg/cm2	MAH									4
TYPE CENT — TUMB   DIESEL   OTHERS   API   ANSI   A	IN MAT: CASE		IMPELLER		dH							-	_	
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EASIF PLANT PROD FACT LOC.M.H. BY 45 JOB NO. LIBULIAS WAGE RATE LAB COST REV. /	TOTAL THIS PAGE													_
EASIF PLANT PROD FACT LOC.M.H. BY 45 JOB NO LIBULIDS WAGE RATE LAB COST REV. /	TOTAL ACCOUNT												4	4
LIGUIDS WAGE RATE LAB COST REV. /	1 1	a5-300/c	SMIND FLAINS	11	=	<b>-</b>	LOC. M.H.	<del></del>		<b>9</b> 4	W	<b>Q</b> :	b	Acc
LIGUIDS WAGE RATE LAB. COST REV. /	LOCATION BET	JLA , NOR!	TH DAKOTA	- {	-	+		+			9-9-	一,		<b>&amp;</b> T
	MOJECT JET F	WEL PROH C	OAL DERING		=		LAB COS			REV.				1

Control   Cont											
Care   Court   Cour				ESTIMATE	SHEE					Bio	ornfield
REG EAST CONTINUED   REG EAST CONTINUED   REG EAST COST COST COST COST   CONTINUED					no .	NATITY	UNIT	MATERIAL		LABOR WH	SUBCONTRA
Continue C	<b>5</b>	SCHIPTION			REO	EA	COST	COST	_	TOTAL	COST
Such 2524 Structure 1916 May 1976 May	PECYCLE		4		i						
MATT LANDLED   1976 ft = 33° C ft + 4   27   ww	CAP SCFM 7624 STM		hPa hg/cin²	12/26	<b>STAKE</b>	,		00 mg/			
Second   1972   Second   19	MAT'L HANDLED ~	- 3	6 CH++	Ž							
DISCHIES AND   STATE   STAT			201								
MATE CASE   CAS   IMPERIENCE   CAS   WOLTS     INSUL   CASE   C	ризсн	Lacen (D)	l								
Intercetal Circle   1805   Bit	MAT CASE CS	IMPELLER	52	VOLTS							
THE CEAN   LURE & SEAL BUNTENCOLEN   SOREN	7 DRIVER EM TURB DIESEL	5081	BHP /	kW.					_		
1980.	BINCL: GEAR LUBE & SEAL SINTER		43	THE UNITE							
CONTINUED     CONTINUED   CONTINUED   CONTINUED     CONTINUED     CONTINUED     CONTINUED     CONTINUED     CONTINUED     CONTINUED   CONTINU											
Cate   102 MS F UEL GAS   Colambded of Part   Cate   Ca	10 INSUL		ERECT. WT. CO			TONS			-		
CAP SCH / Z 667   STW   PSIG   Wight   PTO 1 2.05	GB 102				7				  -		
SUCT 15-7 FILM  SUCT 15-7 FIL	CAP SCFM		1	P2/P1 2.				300,000			
MAT. CASE   CAST   TANN   WAS   TEMP 1/0 o'F   O'C	<b>42</b>	145		7.81							
MAT. CASE   MATELIER   CS   VOLTS   STGS	SUCT /5.7 PSIA/	-	0/								
MAT. CASE   WATELLER   CS   VOLTS	15 DISCH 44.7 PSIA!		7.2	STGS							
INCL. GEAR     LUBE B SEAL     AZO BHP     INVECENT   RECIP   ROTARY   SCHEM   COMPR. + DRIVE   TONS	57	MPELLER	52	VOLTS							
WELL GEAT   LUBE & SEAL     WHER COOLER   COND	17 DRIVER EM TURB DIESEL	l	446	kW							
10   10   10   10   10   10   10   10	18 INCL: GEAR   LUBE & SEAL   X IN		☐ covo [								
1950     1950		SCREW []									
CAP SCFINE   STM   PSIG   LANGE   PRIA	20 INGUL [		ERECT WT CO			TONS					
MATE HANDLED   NAME   PSIG	21 GB-										
BUCT   PSIAV   Wilton   PSIAV	CAP. SCFM	/Sisa	kpla kolem²	P2/P1							
SUCT   FSIAL   Wilter   TEMP   OF   OC	MAT'L HANDLED										
DISCH         FSIAV         LUBE A         COLOR         STGS         PARTICASE	SUCT PSIA/			ာ့							
MAT. CASE  DRIVER EW   TUBE B. SEAL   IMPELLER  DRIVER EW   TUBE B. SEAL   INTERCOOLER   COND    INCL. GEAR   LUBE B. SEAL   LUBE B. SEAL   COND    INCL. GEAR   LUBE B. SEAL   LUBE B. SEAL   COND    INCL. GEAR   COND	DISCH PSIA/	_	رح	STGS							
INCL. GEAR   LUBE & SEAL   INTERCOOLER   COND   COND     INCL. GEAR   LUBE & SEAL   INTERCOOLER   COMP + DRIVE     INCL. GEAR   LUBE & SEAL   INTERCOOLER   COMP + DRIVE     INCL. GEAR   LUBE & SEAL   INTERCOOLER   COMP + DRIVE     INCL. GEAR   LUBE & SEAL   LUBE   COND     INCL. GEAR   LUBE & SEAL   LUBE   LUBE     INCL. GEAR   LUBE & SEAL   LUBE     INCL. GEAR   LUBE   LUBE     INCL. GEAR   LUBE   LUBE     INCL. GEAR   LUBE   LUBE     INCL. GEAR   LUBE     INCL. GEAR   LUBE   LUBE     INCL. GEAR   LUBE     INCL. GEAR   LUBE   LUBE     INCL. GEAR   LUBE     INCL. GEAR   LUBE     INCL. GEAR   LUBE   LUBE     INCL. GEAR   LUBE     INCL. GEAR   LUBE   LUBE     INCL. GEAR   LUBE     INC	MAT. CASE	MPELLER									
INCL. GEAR   LUBE B SEAL   INTERCOOLER   COND    TYPE: CENT   RECIP   ROTARY   SCREW    INSUL    INSUL    TOTAL THIS PAGE  TO		8	/dHI	kW							
INSUL DISTRICT RECIP DISTRICT BRECT WT. COMPR + DRIVE TOTAL THIS PAGE  TOT		TERCOOLER [	] conp								
HIS PAGE  CCOUNT  HIS PAGE  CCOUNT  HIS PAGE  CCOUNT  HIS COLDAY, VOSTA DAKOTA  M. BCULAH, VOSTA DAKOTA  HIS COST  H		SCREW []							_=		_
HIS PAGE CCOUNT  HIS COUNT  HIS COLONT  HIS COLONT  M. BECULAH, VERTH DAKOTA  M. BECULAH, M. BECULAH, M. BECULAH  M. B	30 INSUL [		WT			TONS					
BONE - GREAT 12 AINS GALVE, 12 ALT PROD FACT LOC MH BY 65 JOB NO. 5571  BECULAH, NO. 274 DAKOTA FUCE FROM CIAL DERVED LIVELING WAGERATE LAB COST REV 2	TOTAL THIS PAGE										
BUE-GREAT PLANS GALVE, 19 ANT PROD FACT LOC MH BY 65 NOB NO. 5571 SCULAH, NO 274 DAKGTA FUCL FROM CAL DERIVED LALUE WAGE RATE LAB COST REV 2	TOTAL ACCOUNT										
BEUCHHINGSTH DAKOTA WAGERATE LAB COST REV 2			1			FOC &		βA	65	2	
TET FUCL FROM EIAL DERIVED WAGE HATE LAB COST REV 2	LOCATION BEULAH, IV	·			+		+	VQ		EST	Ţ
	PROJECT JET FUCL FROM	1	REPIVED LA		<u></u>	LAB COST		<u> </u>		_	-

A	AREA 100	0					
ESTIMATE SHEET	SHEET	-			Ŧ	E LUMMU	THE LUMMUS COMPANY Bloomfield
	OUA	OUANTITY	UNIT	MATERIAL	STD LABOR MH		
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PA -103							
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LOCATION BELLEM, NORTH DAKOTA	+		-	DATE	2/23/09 15	١	
troat		LAR COST		> 2E	,		<b>-</b>

	o Cana							1.
STIMATE SHEET	SHEET					THE LUMM	THE LUMMUS COMPANY Bloomfield	
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DESCRIPTION	RE0	ΕA	COST	COST	TINO	TOTAL	COST	
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1000/005 GREAT PLO		H W 301		RY	50	ON BOY	557/ AC	ACCT
PROJECT TET EST FOR COA MOUTEN (1001/05) WASSERVED		1 AR ( 0'51	· •	7 121	2/2	الله الله الله الله الله الله الله الله		
7	:							].

CLIENT: DOE

PROJECT:5571

LOCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

21-Apr-89

03:36 PM

**EQUIPMENT** 

PCS. S EOUIP.

\$ COMM

\$ COMM

2	\$370	60%	\$222
3	\$81	110%	\$89
	\$19		
1	\$900	70%	\$630
10	\$376	90%	\$338
2	\$88	90%	\$79
9	\$266	100\$	\$266
12	\$315	100%	\$315
6	\$5,100	60%	\$3,060
45	\$7,515		\$5,000

SUMMARY

EQUIPMENT

\$7,515

COMMODITIES

TOTAL

\$5,000

LABOR

\$3,751 (10% EQUIP,60% COMM)

INDIRECTS

\$3,751 (100% LABOR)

**ENGINEERING** 

\$2,700 (1000/PC X \$60)

SUBTOTAL

\$22,717

CONTINGENCY

\$4,543 (20%)

TOTAL

\$27,261

PSA

\$7,500 PSA 5MM X 1.5 TIC

TOTAL

\$34,761

International Company   Inte													
ED   HEATER   CORN   TOTAL   L.60		MANUS			ESTIMATE	SHEE	<b>.</b>				Ē	E LUMBOU	SCORPAN
FED HEATER   FISION   FOTAL   1   1   1   1   1   1   1   1   1		0690	MOLLAND			ð	JANTITY	TINO	MATERI	-		-I _	Bu second
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MER FEED HEATER   TONS   3000 0000									+	+	$\downarrow$	1	
FEED HEATER /		CONOMIZER			ERECTWI		TONS		$\dagger$	+	$\downarrow$		1
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1.00 (4)   25.00   1.00 File   25.00   1.00 File   25.00   2	ABSORBED DUTY		VNOO	_	TOTAL				3	1	$\downarrow$	+	
FLUID   C   GOO OF   W.   C   FOK STEAM QUL   RTICAL     FATIAL   C   GOO OF   C   FOK STEAM QUL     FATIAL   C   GOO OF   C   GOO OF     FATIAL   C   GOO OF	Mad Day	24.00	<u>ا</u> ا	1	25.00				1	+	+	+	
FLUID   C   GOO	NA.			-					+	+	$\downarrow$	1	
FLUID	DES PRESS	150 rsia	ì	1	2				+	+	+	1	1
FILAL   C.S. FOR. STEAM WILL   TOWS   TOTAL   TOWS   TOTAL   TOWS   TOTAL   TOWS   TOTAL   TOWS   TOTAL   TOWS   TOTAL   TOTAL   TOTAL   TOWS   TOTAL   TOWS   TO	DES TEMP	8	<b>℃</b>		ွ				+	+	+	T	+
EATING	MAT TUBES	502 - 1/2 Mg	0	FOK					+	+	1	1	+
GRECT.WT TOTAL  CONV TOTAL  TOTAL  CONV TOTAL  TOTAL  CONV TOTAL  TOTAL  CONV TOTAL  T	34	CYL. VERTICAL							+	+	+		+
CONV TOTAL  OCONV TOTAL  OC OF OF OCC  OC OF OCC  OC OF OCC  OC OF OCC  OC OF OCC  OCC	(e) 5TEA	IM SUPERHEATING	Ŋ,						+	+	+		1
GRIM FLAIMS CALIF. TLAAT  GRIM FLAIMS CALIF.	MEMEATER LJE	CONOMIZER			ERECT. WIT		TOMS		+	+	1	1	+
GAT PLANKS CALIFE, 17.0AT         FRICE INT         TOWN         TOWN         FIRTH STATE         TOWN         FIRTH STATE         TOWN         FET IND         SS 71           CLOS AT PLANKS CALIFE, 12.0AT         FRECT WT         TOWN HILLS         BV         HILLS         DOATE 11/E 13/E1         EST MO. SS 71	ž								-	+	1	1	$\dagger$
GET AT PLANUS CALLY FROD FACT LOC M.H. BY HILL DO FOLLOWER LINE CALLY CALLY FOLLOW HILL DO FOLLO	ABSORBED DUTY		<b>200</b>		TOTAL				+	+	$\downarrow$	+	+
	AM Broft			-					+	+	$\downarrow$	+	1
GAS MT PLANUS CALLIFE. I'LLAKT LESSEM DATE OF BOOK FACT LESSEM DATE OF BOOK FACT LOCUM.  BY HILLE DO FOUNDS  WAGE FLATE FOR THE FLOTE  LOCUM.  BY HILLE DO FOUNDS  WAGE FLATE FOR THE FLOTE  DATE IT BE FOUNDS  WAGE FLATE  DATE OF BOOK FOUNDS  WAGE FLATE  DATE IT BE FOUNDS  WAGE FLATE  DATE OF BOOK FOUNDS  WAGE FLATE  WAGE FLATE  WAGE FLATE  WATHER FLATE  WATHER FLATE  WATH	A.								-	+	+	1	+
GAS MT PLANUS CALLIF. I'LALT FROD FACT LOC MH BY HILL DO FORT CALL DE LIGHT LOC MH BY HILL DE LIGHT LOC MH BY	NES PRESS	5084	S &	PSIG	200				+	+	1	1	+
GRECT WT TONS GREAT TONS GREAT PLANTS CALLE TEAT HODE FACT LOC MH  CESTA DATA OF H  CHART PERMISSION OF STATE OF HIGH AND SSTUDENT OF STATE OF STAT	SES TENP	/\$	သို	30	၁				-	+	$\downarrow$	+	+
GREAT PLANTS CHIST. TLAKT PROD FACT LOCIMH BY HILL DB NO. 5571	AAT TUBES								-	+	1	+	+
GET AT PLAINS WAITH TEAM TONS  GET AT PLAINS WAITH TEAM TONS  LOC M.H. BY HILL DO NO. 5571  CONT. CAL. PRINTETT INDICATE TO ST. 1989	VPE								-		-	1	+
GET MT PLAINS CALLY FROD FACT LOC M.H. BY HILL JOB NO. 5571									-	-	1	+	+
S CALLE TLAKT PROD FACT LOC MH BY HILL JOB NO. 5571	MEHEATER DEC	CONOMIZER			1.		TOWS		+	+	$\downarrow$	1	+
S CALLE TLAKT PROD FACT LOCIMH BY HILL JOB NO. 5571	TOTAL THIS PAGE					T			+	1	$\downarrow$	†	+
SCALIF. TLAKT PROD FACT LOC MH. BY HILL JOB NO. 5571	TOTAL ACCOUNT								-	+	-	#	+
CITY TOPOLDS WAGEBATE LAB COST	LOCATION PE	30100 - GAM,	PLAINS CALL	- 1	$\overline{\Box}$		LOC. M.H.		à			وَ	
	MOJECT JET	FUEL FRUITCH	1 7 CAC	110.01	T		LAB COST		VO S	32 ·	_		Т

SUBCONTRAC THE LUMMUS COMPANY COST **Bloom/eld** STD LABOR MH TOTAL CNIT 000 000 800 3 MATERIAL COST 25 14 Ń COST 21 312 33000 LBS 7000cl TONS 300 TONS 200 Ę DUANTITY 200 **ESTIMATE SHEET** REO AREA ٤ E ں 25' SKIRT HT SKIRT HT 0 jo ١٥ Ibs ERECT WT ILS ERECT WI 30 VALVE TRAYS 6 VALVE TRAYS 730 PSIG DESTEMP 500 410 55 41055 PSIG DES TEMP hycms DES TEMP Advent DES TEMP \$2, 5 S X RAY.SPOT | 100% | STRESS REL | FAB.SHOP | FIELD | X RAY SPOT [ ] 100% [ ] STRESS REL [ ] FAB SHOP [ ] FIELD | ¥ ¥ 18 INTERNALS TRAYS-INSTALLED SHOP [MELD [] INTERNALS TRAYS-INSTALLED SHOP [ FIELD CLAD [V LINING [] CLAD [] LINING [ JP8 PRODUCT STRIPPER 20,-0,, 11 DESCRIPTION 50-0" Ba 08 75 . 90 10 10 10 TOWER 9 9 WORTEX BREAKER JP8 7-6" . V . ₽ 3'-0" S S DES PRESS DES PRESS IS DES PRESS DES PRESS DA 202 13 m | mm | 10 INSUL 20 INSUL [1] - L DA 201 MAT ¥

28 INTERNALS TRAYS INSTALLED SHOP[]FIELD[] 10 VALVE TRAYS	175	300	3000			
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CLIENT AMLLY / POB-GREAT PLAINS GASIF. PLANT	PROD FACT	H <b>W</b> 301	84	BY HHK JOB NO. CC71	, 5571	ACCT
LOCATION BEULAH NORTH DAK TA			DATE	(1.8 1989 EST		<b>V</b>
<u>`</u> .	JOUNDS WAGE HATE	LAB COST	> 3 =	C		
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5000LBS

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Antimo DES TEMP

X RAY SPOT [ ] 100% [ ]STRESS REL [ ] FAB SHOP [ ]FIELD [ ]

ESTIMATE SHEET	SHEET				THE LUMMUS COMPANY	COMPANY
	DUANTITY	-	MATERIAL	STD	STD LABOR MH	SUBCONTRACT
OFSCHIFTION	HEO] FA	COST	cost	LINO	TOTAL	COST
1 DC 201 HDS REACTOR /	000/09/2	6 3,8	900 000			
ז פי-0" ום 30-0" זד זא אוא גאואדאד Skint או			_			
4 MAT 2/4C3 - 1/2 MO CLAD   LINING   1 CA mm						
5 DES PRESS 2600 PSIG DES TEMP 830 "1						
6 DFS PRESS kq/rin2 DES TEMP OC						
7 X RAY SPOT   1100% [V]STRESS REL[ JFAB SHOP   1116LD [ ]						
ES . HOLDOWN						
	TONS					
100						
12 IK SKIHTHT	:					
13 m [] mm []						
14 MAT CLAD[]LINING[] CA / 111m						
IS DES PRESS PRESS						
16 DES PRESS byland DES TEMP "C.						
17 X RAY SPOT [ ]100% [ JSTRESS REL [ ]FAB SHOP   FIELD   ]						
18 INTERNALS						
6:						
20 INSUL []HORIZ [] VERT []	LONS					
2) DC						
22 ID IT TK SKIRTHT						
23 m J mm ( )						
24 MAT CLAD[ LINING ] CA / mm						
25 DES PRESS						
26 DES PRESS kyun? DES TEMP OE						
27 X RAY SPOT [ ] 100%   STRESS REL   FAB SHOF   THELD						
28 INTERNALS						
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CLENT DOE/AMOLO - GREAT PLAINS GASH (LAN) T HERED FACE	1 W 101		HY	HHK	NOB NO	17.35
Henry Co. T. Co. Co. Co. Co. Co. Co. Co. Co. Co. Co	1.101.119.1				_	ن ا

			AUCA	202					٠, ١		
N	ST COMMUS	ESTIMATE SHEET	SHEE	<b>-</b>					1745 LU <b>BRAN</b> 810	Bloomfeld	≥
			0	DUANTITY	TINO	MATERIAL	14	STOU	STD LABOR MH	SUBCONTRAC	RACT
	DESCRIPTION	20	REO	TOTAL	COST	COST		UNNIT	TOTAL	C05T	
16A 201	HDS REACTOR FEED/	EFFLUENT EXCHANGER /	-						-		
2 SIZE IN DAL	mm D/L	TYPE DES OR EQUIV.									
3 NO SHELL/SERV.	ONE SOFT/SHELL	1850 TOTAL SOFT 1850 ISERV		1850 SOFT	125	122	200				
A NO SHELL/SERV		TOTAL m2 ISERV		E W							
		mm TUBE SIDE C.A. mm									
PKAT	12 Mo	21/4 CA - 1/2 MO									
7 DES PRESS	2300 msic/	3600									
OES TEMP		₹ 008									
9 TUBES DIA	GA IMM AV	DED SMLS TEXP JOINT									
10 TUBE ENDS	10 TUBE ENDS WELDED   NO. TUBES	MSUL [] ERECT WT		TONS EA							
11 EA. 202	$\sim$	IMS EXCHANGER V	-								
12 SIZE IN DAL	men D/L	TYPE AEU									
13 MO SHELL/SERV	ONE SO	240 TOTAL SOFT 240 ISENV		2HO SOFT	35	<b>48</b>	400				
14 PMO SHELL/SERV		101AL m2		m <sup>2</sup>		1 1					
2	HELL SIDE C.A. '/8"	mm TUBE SIDE CA 1/8" mm									
10 MA 7		\$3									
17 OES PRESS	150 7816	175 esig/									
18 DES TEMP	300 06	30 /40 059 30									
18 TUBES DIA	OVE ONE	WELDED SALS [ EXP.JOINT []									
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21 EA 203	JPS TOWER OVERHEAD COND	NDENSER /									
ZZ SIZE IN DAL	mm D/L	TYPE AEU									
Z3 MO SMELL/SERV	ONE SOFT/SHELL	5250 TOTAL SOFT 5250 ISERV		52 <b>50 SOFT</b>	0/	53	مده				
20 MO SHELLISERY	•	TOTAL m2 /SERV		z w							
×	SHELL SIDE C.A. 1/8" mm	m TUBE SIDE CA 1/8" mm									
28 MAT	,S	5)									
27 DES PRESS	75 PSIG/	(Sec. 150 PSIG)							_		
28 DES TEMP		300 01									
29 TUBES DIA	OV ONIN	WELDED[] SMLS[] EXPJOINT[]									
30 TUBE ENDS	TUBE ENDS WELDED THO TUBES	JINSUL [ ] ERECT WT		TONSEA							
TOTAL THIS PAGE	PAGE										
TOTAL ACCOUNT	DURET										
CLIENT AL	CLIENT ANOCO JOCE - 4 PEAT PLA	LAINS GASTE PLANT PROD FACT	CT	LOC MM			- 1		K 108 NO. 5.	27/	ACCT
LOCATION	LOCATION BELLCAFT NICKTH -	- V17776			-	Ī	<u></u>	F1 5. 1983		i	E
				AVC UNIT	-	=	?	ς.			_

EA 2014 HAF STABLLISER FEED/BUTTOMS EXCHANG BIZE IN DIL  MO SHELLISERV. ONE SOFTSHELL 100 TOTAL SOFT WO SHELLISERV. ONE SOFTSHELL 100 TOTAL SOFT WO SHELLISERV. ONE SOFTSHELL 100 TOTAL MAT  BOESTELMS ITS PSUG OF OC HOO OF HOO O	<b>E</b> -	QUANTITY Q TOTAL	UNIT				Moorn etc
EA 2014 NAF. STABILISER, FEED/BUTTOMS EXCHANGER  SIZEN DAL  MO SHELLSERN. ONE SOFTSHELL (00 TOTALSOFT WO MO SHELLSERN. ONE SOFTSHELL (00 TOTALSOFT WO MO SHELLSERN. ONE SOFTSHELL (00 TOTALSOFT WO MO SHELLSERN. ONE SOFTSHELL (100 TOTALSOFT WO MO SHELLSERN ONE SOFTSHELL (100 TOTALSOFT SOFTSHELL (100 FS))  EA 205 NAF. STABILISER REBOILER. TYPE AKT  MO SHELLSERN ONE SOFTSHELL (100 Of SOTTSHELL (100 OF SOTTSHE	<del> </del>   -	TOTAL	125				
EA. 2014 HAF. STABILISER FEED/BUTTOMS EXCHANGER.  SIZE 18 DIL  SIZE 18 DIL  SIZE 18 DIL  NO SHELLYSEN.  SHELL BIDE C.A. \(\frac{1}{3}\) \(\fr	-		COST	COST	STO	STD LABORAMY	SUBCONTRAC
NO SHELL/SERV. ONE SOFTSHELL 100 TOTAL SOFT 100 NO SHELL/SERV. ONE SOFTSHELL 100 TOTAL SOFT 100 NO SHELL/SERV. ONE SOFTSHELL 100 TOTAL SOFT 100 NO SHELL/SERV. SASHELL 100 TOTAL SOFT 100 NO SHELL/SERV ONE SOFTSHELL 370 TOTAL SOFT 370 NO SHELL/SERV ONE SOFTSHELL 370 NO SHELL/SERV ONE SOFTSHELL 370 TOTAL SOFT 370 NO SHELL/SERV ONE SOFTSHELL 370 NO SHELL/SERV ONE SOFTSHE SOFTSH						-	
NO SHELLSERV. ONE SOFTSHELL 100 TOTALSOFT 400  NO SHELLSERV. M²FSHELL TOTAL M²  DES PRESS 175 9545	\$						
SHELL SIDE CA \( \frac{1}{2} \)		100 SOFT		5000			
MAT  OES FREES  175 PSIG  DES FREES  176 PSIG  DES FREES  176 PSIG  DES FREES  177 PSIG  DES FREES  178 PSIG  DES FREES  178 PSIG  DES FREES  179 PSIG  DES FREES  170 PSIG  DES FREES  170 PSIG  DES FREES  170 PSIG  DES FREES  170 PSIG  DES PREES  DES PREES  DES PREES  DES PREES  DES PREES  DES PSIG  D	<u></u>	ZΨ					
DES FREES  175 PSIG  DES TERM  300 05  TUBES FORS  100 05  TUBES FORS  100 05  TUBES FORS  100 05  10	Ę						
DES FRESS 175 PSIG							
DES TEMP 300 OF HOO OF HOO OF HOO OF TUBES DIA GA MAN   AV   WELDED   SALLS   EXPLOINT    TUBE ENDS WELDED   MO TUBES   SALLS   EXPLOINT    EA. 205 HAP. STABLLISER, REBULER  SHELLSENV ONE SOFTSHELL 370 TOTAL M3 TO SHELLSENV ONE SOFTSHELL TOTAL M3 TO SHELLSENV ONE SHELL STORM TOTAL M3 TO SHELLSENV ONE SIGN OF CS TO SHELLSENV ONE SOFTSHELL   70 TOTAL M3 TO SHELLSENV ONE SOFTSHELL   70 TOTAL M3 TO SHELLSENV ONE SOFTSHELL   70 TOTAL M3 TO SHELLSENV ONE SIGN OF CS TO SHIP SHIP SIDE CA 1/8"    MAT CS CS MAN   AV   WELDED   SHILS SOFT   70 TOTAL M3 TO SHELLSENV ONE SIGN OF CS TO SHIP SHIP SIDE CA 1/8"    MAT CS CS MAN   AV   WELDED   SHILS SOFT   70 TOTAL M3 TO SHELLSENV ONE SIGN OF CS TO SHIP SHIP SIDE CA 1/8"    MAT CS CS MAN   AV   WELDED   SHILS I I KA JOINT I I WELS SIDE CA 1/8"    MAT CS CS MAN   AV   WELDED   SHILS I I KA JOINT I I I WELS SIDE CA 1/8"    MAT CS CS MAN   AV   WELDED   SHILS I I KA JOINT I I WELS SIDE CA 1/8"    MAT CS CS MAN   AV   WELDED   SHILS I I KA JOINT I I WELS SIDE CA 1/8"    MAT CS CS MAN   AV   WELDE CS I SHIP SHIP SHIP SHIP SHIP SHIP SHIP S							
TUBES DIA GA BONN   AV   WELDED   SMLS   ENP LOINT    EA 205 HAP, STABILISER REBOILER    SAELLSENV ONE SOFTSHELL 370 TOTAL SOFT 370 F  NO SHELLSENV ONE SOFTSHELL 370 TOTAL R370 F  NO SHELLSENV ONE SOFTSHELL 370 TOTAL R370 F  NO SHELLSENV ONE SOFTSHELL 10TAL R370 F  NO SHELLSENV ONE SOFTSHELL 10TAL R370 F  NO SHELLSENV ONE SOFTSHELL 10TAL R370 F  NO SHELLSENV ONE SOFTSHELL   TVPE AEU OR  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 TOTAL SOFT   70 IN  NO SHELLSENV ONE SOFTSHELL   70 IN	3						
EA. 205 NAP. STABILISER REBOILER   SAZE-IN DIL  SAGELISERVO   SAGELISER							
EA. 205 HAP. STABILISER, REBOILER \ MOSHELLISERV ONE SOFTISHELL 370 TOTAL m² MOSHELLISERV ONE SOFTISHELL 370 TOTAL m² MAT SHELLISERV ONE SOFTISHELL 370 TOTAL m² MAT CS CS CS CS CS  MAT CS PRIES  MA	1	TONS EA					
NO SHELLSERY ONE SOFTSHELL 370 TOTAL SOFT 370 FOR SHELLSERY ONE SOFTSHELL 370 TOTAL SOFT 370 FOR SHELLSERY ONE SOFTSHELL 370 TOTAL M2 FOR MAT SHELL SIDE CA 1/8" mm TUBE SIDE CA 1/8" CS CS CS SOFTSHELL 170 FSIL. CS CS SOFTSHELL 170 FSIL. CS	-						
MO SHELLSERV ONE SOFTSHELL 370 TOTAL SOFT 370 KD SHELLSERV.							
### 100 SHELL/SERV. ####################################	^	370 50 11	52	کوہ 7			
### 108E SIDE CA 1/8" mm 108E SIDE CA 1/8" CS  DES PRESS   150 PSIG   175 PS	^	m <sup>2</sup>					
DES PRESS   50 PSIG   175 PSIG   CS    DES TELM   1400 OF   0 C   500 OF    TUBES DIA GAMIN   AV   WELDED   SMLS   EXPLOINT   1    TUBES DIA GAMIN   AV   WELDED   SMLS   EXPLOINT   1    TUBE ENDS WELDED   WO TUBES   1    EA 206   NAP. STABILISER O   1 COADE ASER. V    EA 207   NAP. V    EA 208   1 COADE ASER. V    EA 208	É						
DES PRESS   150 PSIG   150 PSIG   175 PSIG   175 PSIG   170 PSIG							
DESTERP   HOO OF   OC   500 OF    TUBES DIA GAMM   AV   WELDED   SMLS   EXPLOINT   I  TUBE ENDS WELDED   NO TUBES   INSUL [ ] FREC  EA. 206   NAF. STABILISER O/H CANDENSER    SIZE IN DIL	• È						
TUBE S DIA GA MING   AV   WELDED   SMLS   EXP JOINT        EA 206   NAP. STABLLISER 0/H GAV DENSER V  SAZE IN DAT	c						
EA. 206   NAP. STABLISER 0/H CONDENSER. V.  SIZE IN DIL.  MO SHELLISERV. DAE SOFT/SHELL   70 TOTAL SOFT   70 TO TOTAL MO SHELLISERV.  MO SHELLISERV. M. F. SOFT/SHELL   70 TOTAL M. R.  MAT SHELLISERV. M. F. SOFT/SHELL   70 TOTAL M. R.  MAT CS  DES PRESS   50 PSIG   10 M. R.   10 BL SIDE CA   1/8   1/8    MAT CS  DES FEMP   300 OF   0   1/8   1/8   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   SMISI   1 KP JOINT   1/8    TUBES DIA GAMIN   AV   WELDED   1/8							
EA. 206 NAP. STABLISER 0/H CONDENSER.  MOSHELL/SERV. DAE SOFT/SHELL   70 TOTAL SOFT   770 11  MOSHELL/SERV. MATSHELL   70 TOTAL SOFT   770 11  MAT SHELL SIDE CA   1/2   mm TUBL SIDE CA   1/8      MAT CS CS  DES PRESS   150 PSIG   1/2   mm TUBL SIDE CA   1/8      DES TEMP   300 OF   0 CS  TUBES DIA GAMIN   AV   WELDFU   SMIS    (XP JOINT	Į	TONSEA					
### SAFE IN DAL	-						
MO SHELL/SERV. 0/16 SO FT/SHELL   70 TOTAL SO FT 170 TO							
SHELL/SERV.   m <sup>2</sup> /SHELL   101A1 m <sup>2</sup>   75   SHELL SIDE CA  /g*   mm   TUBL SIDE CA  /g*	>	170 SOFT	4	6000			
SHELL SIDE CA   g   mm TUBL SIDE CA   g   AAT   CS   CS   CS   CS   CS   CS   CS   C	>	m2					
MAT         CS         NP 20         CS           DES PRESS         150 PSIG         NP 20         01           DES TEMP         300 0F         0C         300 0I           TUBES DIA         GA MIN [] AV [] WELDED [] SMIS [] (XP JOINT []	£						
DES FRESS         150 PSIC, 150 PS							
DESTERM 300 OF UC 300 UI TUBES DIA GAMIN AV WELDFULL SMISL LEY JOINTE	,,,						
TUBES DIA GAMINE AVE WELDED I SMEST I EXPJOINTE	ن						
30 TUBE ENDS WELDED LING TUBES INSUL	WI	TONSTA					
TOTAL THIS PAGE							
TOTAL ACCOUNT					II		
7///	FACT	10C 18 H		<b>&amp;</b>	35	HIR JOB NO 5	125
HOCATION SELLARY MORTH NATIONA			-	DATE	11.6	٦,	<b>W</b>

					207						Г
M	SUMMUS P	;	ESTI	ESTIMATE SHEET	ET				THE LUMMAUS COM	MUS COMPANY Moonfield	
		1012010200			QUANTITY	UNIT	MATERIAL	sto	LABOR MH	SUBCONTRAC	15
		DESCRIPTION		REO	TOTAL	COST	COST	<b>TIM5</b>		7502	
1 EA 207	STABILISFD	NAPHTHA COO	1.E.R. ~								T-
2 SIZE-IN DIL		mm D/L	TYPE AEU OR D	DΡ							Т
JMO SHELL/SERV.	MV. 300	-	300 TOTAL SOFT 300	/SE PIV	300 50 FT	30-1	9000				Т
A MO SHELL/SERV.		m2/SHELL	101AL m2	/SE RV	₹		-				т_
•	SHELL SIDE C.A. 1/g"	www / <sub>8</sub> 8/1 ×	TUBE SIDE C A 1/6"	E							T-
PAAT											Т
7 DES PRESS	150 PSIC	200	150 150	- Car			L				T
DES TEMP	300 00	၁	300 06	۶							Т
TUBES DIA	O MIN	O AV O WELDED	ā				-				Т
TUBE ENDS	10 TUBE ENDS WELDED   MO. TUBES	Ш	פתר []	T W.T	TONS EA						T
11 EA. 208	MAKE UP #	COMPRESSOR C	UNTIAN COOLE R	-			_				Т
12 SIZE IN. D/L		men D/L	TYPE AET OR	DΡ			-				T
13 NO SHELL/SERV	AV ONE	3	D TOTAL SOFT 300	SERV	300 50 FT	45-1	13500	a			1
14 PED SHELL/SERV	AV	m2 13HELL	TOTAL m2 /	/SEAV	<b>E</b>		_		-		Т
91	SHELL SIDE CA 1/8"	ww. / <sub>11</sub> 8/1 ∨	TUBE SIDE CA 1/8"	Ę			-		<u></u>		T
16 MAT	0		5.)								lacksquare
7 DES PRESS	150 PSIG	Carried	59.00 PSIG	10 mg							_
B DES TEMP	150 05/	<b>3</b> 6	300 °F/	o <sub>C</sub>							_
10 TUBES DIA	CA MIN	] AV [] WELDED	_								1
TUBE ENDS	20 TUBE ENDS WELDED NO TUBES	TUBES	SUL [] ERECT	T. WIT	TOMSEA						
21 EA. 209	243 JIE 68	CAN THE GAS COMPRESSO	R AFTERDOOLER /	-							
ZZ SIZE IN. DAL		mm,D/L	TYPE AEU								
23 NO SHELL/SERV	AV ONE	SOFT/SHELL 12	FT /210	SERV	1210 SOFT	30-	36 300	<u> </u>			_
24 NO SHELL/SERV	AV.	m <sup>2</sup> /SHELL	101AL m <sup>2</sup> //	SERV	2W						_
£	SHELL SIDE C.A. 1/8"	ww / 8/, v	TUBE SIDE C.A 1/8"	Æ							
38 MAT		CS.	5)								
27 DES PRESS	150 PSIG	Spirit Sp	410 PSIG/	hept ni							
28 DES TEMP	/30 0'	ეი	300 01	၁၈							T -
29 TUBES DIA	GA MIN	GA MIN AV WELDED	C SMLS [] EXP JOINT [								1
30 TUBE ENDS	TUBE ENDS WELDED THES		JINSUL! HRECT	1 %	TONSEA						1
TOTAL THIS PAGE	PAGE										•
TOTAL ACCOUNT	DUMT			===							
CLIENT AL	CLIENT APLOCO ,ODE .	SUENT FLAINS	IMBY 3	PHOD FACT	10C M H		λθ	सार ५५	C ON 133	57/ ACCT	
LOCATION	REULAH	BEULAH MORTH JAHOTA		3740 7 743		-	DATE	1111	- 1	<b>*</b>	
						-	>======================================	-			_

COMMITTY   CONTINUED   CONTI		LUMMUS	10		ESTIMATE	SHEE	H				THE LUMM	US COMPANY
A			DESCRIPTION			้อ	JANTITY	UNIT	MATERIAL	STO		Sing Care
						REQ	EA	COST	COST	TINS.	101	COST
MO SHELLYERY GAGE SOFTISHEL	2/2 \	MS EGORCIE	CONTRACTOR	- 1	COOLER	_			_			
			J/O ww	TYPE	のなって							+
MO SHELLSEEL A   MO SHELL   TOTAL M   SEEL A   MO SHELLSEEL A   MO SHELL	_	- 1	SOFT/SHELL /O		00/		100 SO FT		┰			
SHELL SIDE CA		ERV.	m7/SHELL	TOTAL m2	/SERV		m2		+-			1
Section   150 of		SHELL SIDE		TUBE SIDE C.A.					+-			+
	•											
	7 DES PRESS				ka/cm2				+			
TUBEE DIA   CAMIN   DAV   DINE LO   SHALE   LERP DOIN	B DES TEMP		9		100				+			
TOME ENDS WELDED   MO TUBES     MODIL	9 TUBES DIA	GA MIN		SMLS [ ]EXP JOINT					+			
SEE HOLE   SEELLISERY   SOFT/SHELL   TYPE     WO SHELLISERY   SOFT/SHELL   TYPE     WO SHELLISERY   SOFT/SHELL   TOTAL SOFT     WO SHELLISERY   SOFT/SHELL   TOTAL SOFT     WO SHELLISERY   SOFT/SHELL   TOTAL SOFT	O TUBE ENDS	WELDED []NO	TUBES [ ]INSUL				TONSFA		+			
MOSHELLOSEN	I EA.						53.00		1			
Mo SHELLISERY   SOFTSHELL   TOTAL SOFT   SERV   SOFT     Mo SHELLISERY   MO			mm D/L	TYPE								
MOSHELISEN		ERV.	SO FT/SHELL	TOTAL SOFT	SERV		50.67		+			
SHELL SIDE C A	MO SHELL/SI	ERV.		TOTAL m2	/SERV		200		-		+	+
DES FRESS   FSIG   Najem2   PSIG		SHELL SIDE O	.A.	TUBE SIDE C.A.	uuu /				-		1	
DES FREES   PSIG    Nation   PSIG											+	
10   10   10   10   10   10   10   10		PSIG/	kg/cm <sup>2</sup>	PSIG/	kg/cm <sup>2</sup>							
TUBES DIA GAMIN □AV □MELDED □SMLS □ ERECT WT  TUBE ENDS WELDED □NO TUBES □ INSUL □  EA  STELL SIDE C.A.   mm D/L   TVPE   SERV   SO FT    SHELL SIDE C.A.   mm   TVBE SIDE C.A.	DES TEMP	<b>9.</b> 8	<b>3</b> •		ွ						1	
EA.  SIZE IN DIL  WO SHELLISEN SOFT  WO SHELLISEN	TUBES DIA	GA MIN	NS   MELDED   SM	E1 1					+			
SOFT	TUBE ENDS	WELDED   NO	TUBES   INSUL			-	TONSEA					
SOFT   SOFTSHELL   TOTAL SOFT   SERV   SOFT	E175 IN 071											
MO SHELL/SERV   SOFT/SHELL   TOTAL SOFT   /SERV   SOFT   MAZ			mm D/L	TYPE								
SHELL SIDE CA mm TUBE SIDE CA MALE CA CONTROLLA CA COLONT TUBE SIDE CA MALE CA CA COLONT TOTAL ACCOUNT TOTAL A		RV	SO FT/SHELL	TOTAL SOFT	/SERV		SOFT	<u> </u>				
SHELL SIDE CA. mm TUBE SIDE CA MALT SIDE		RV	m <sup>2</sup> /SHELL	TOTAL m2	/SERV		m2					
DES PRESS PSIG KAJCM2 PSIG LAGEM2  DESTEMP OF OC OFF OC  TUBES DIA GAMIN [] AV [] WELDED [] SMLS [] EXP JOINT [] FRECT WT  TUBE ENDS WELDED [] INSUL [ FRECT WT   TONS EA    TOTAL THIS PAGE  TOT		SHELL SIDE C		TUBE SIDE CA	ww							
DES TEMP OF OF OF OF OF OC  TUBES DIA GAMIN[JAV [JWELDED [JSMLS]] EXPLOINT[]  TUBE ENDS WELDED [JNSUL [ FRECT WT TOTAL THIS PAGE  TOTAL THIS P		DESIG.	6 177	21.00	1	1						
TUBES DIA GAMIN[]AV []WELDED []SMLS [] EXP JOINT []  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT PHONT FACT  LOCATION  BENING A CONT  OFFICE FOR THIS PAGE  TOTAL TH		730	zwycmz	200	kg/cm²	1						
TUBE ENDS WELDED CHO TUBES INSUL EFRECT WT TONS EA TOTAL THIS PAGE  TOTAL	3.0	7		) Jan	၁၀							
SECHION ALLT PHON FACT LOCMH BY SS JOB NO 557/	Tibs Sings	CA MIN	= 1	S[]EXP JOINT[]								
24.7. PHOD FACT 10C MH 8Y 55 JOB NO 557/	TOTAL THIS	WELDED LINO	TUBES JINSUL		Rf CT		TONS EA					
PHOD FACT LOC MH 8V 55 JOB NO 557/	TOTAL ACCO	UNT										
14.77 PHOLIFACT 10C MH 6577	CLIENT AND	200/00		7		1						
WACE PATE   LAB COST   BOY	LOCATION	86.144	VOETH SAKOT	THICHTON HALLT		-	10C MH	i	BY		ON 187	
	State of the last	rfill raol	MICHAL AROUM	CA /12.11AC	WAY FRATE	_	HIAH COST		\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		-	3

											Part o same	3	3
IS SLUMMUS	•			ESTIMATE SHEET	SHEE						FINE COMPANY COMPANY OF	Bloomfatd	
					ô	QUANTITY	LINO	MATERIAL	٦٢	STOL	LABOR MH	SUBCONTRAC	RACT
		DESCRIPTION			REO	TOTAL	COST	COST		UNIT	TOTAL	Sos I	
1 EC 201 HDS REACTOR	TOR EFFLUENT	ENT	CONDENSER		1					-			
AL BARE SURF		FINNED/	_	SOFTEA		1700 SOFT	9	089	000				
3 TOTAL BARE SURF		FINNED/		m2EA		_ m							
TUBE MAT CS WITH	- VIO	Z	LENGTH NO	BUNDLES									
S 10 BWG TUBES	E	Ę	LENGTH NO ROWS	HOWS 6									
6 DES PRESS 2600	0 PSIG	0ES 7E	16MP 475 OF	TOTAL HP 25						_			
DES MRESS	LOCE IN	DES TE	EMP OC	TOTAL NW									
8 NO. FANS ONE EA /HP	1 52	A.											
9 KNOCK DOWN/PREASSEMBLED	reo												
10 INSUL				ERECT WT		TONS EA							
2 Jr8	PRODUCT COO	COOLER	\							-			
AE SURF	008	FINNED		SOFTEA		800 SOFT	25	200	000				
13 TOTAL BARE SURF		FINNED		m <sup>2</sup> EA		Z <sup>w</sup>					_		
14 TUBE MAT (S	OHA OHA	ž	LENGTHING BUNDLES	BUNDLES									
15	•	JJ LJ	LENGTH NO ROWS	ROWS 6							_		
16 DES PRESS 175	PSIG	DES TE	TEMP OF	TOTAL HP 10									
17 DES PRESS H50	Carrier C	DES TE	OC LEMP	TOTAL LW									
18 NO. FANS ONE EA HE	1 01	MI											
OMENDER	LED												
20 INSUL []				ERECT. WT.		TONS EA							
2) EC													
22 TOTAL BARE SURF		FINNED/		SOFTEA		SOFT							
23 TOTAL BARE SURF	_	FINNED/	/	m²EA		m <sup>2</sup>							
24 TUBE MAT	) VIQ	IN.	LENGTH NO. BUNDLES	BUNDLES									
æ		u.	LENGTHINO	NO. ROWS									
26 DES PRESS	PSIG	DES TE	AP.	TOTAL HP									
27 DES PRESS	Legal Page		OC JESTS	TOTAL NW									
26 NO FANS EA/HP	/	**											
29 KNOCK DOWN/PREASSEMBLED	LED								-	_	_		
DOINSUL []				ERECT. WT		TONS EA							
TOTAL THIS PAGE									F	-			
TOTAL ACCOUNT													
CLIENT Appois / POC - GREAT 12AINS G	-GRUAT I	NINS	GASIF. FLANT	PROD FACT	15	LOC. M.H.			97	善	ON BOY	1255	ACCT
LOCATION BEVLAH, HERTH DAKETA	H, HCFT,	2	KCTA	1	1	+	+	Ť	DATE FEB.	136.1			EC
PROJECT JET FUEL FROM COME DE 2011 1 LIQUIDS	EPall CCP	I'M	110017 ( 11001	7) WAGE HATE	-	LAB COST	_		HFV	c			

REA 200

							716	2 21 19 10	PAG A IMPORT COMPANY	_
ESTIMATE SHEET	SHEE							Moomiete		
	8	QUANTITY	CNIT	MATERIAL	<u> </u>   7	· STD	LABOR MH		BUSCONTRACT	-
DESCRIPTION	HEO	EA	COST	COST		TIMO	TOTAL		COST	
1FA 201 HDS FEED SURGE DRUM /	_				F					
2 5-0" ID 25-0" TT TK 30' SKIRT HT		13000 LBS	121	23 0	000					
4 MAT (S CLAD   LINING   CA 1/8" / mm										- 1
MESS										7
6 DES PRIESS APR. DES TEMP OC										
7 X.RAY.SPOT [] 100% [] STRESS REL [] FAB.SHOP [] FIELD []										1
BINTERNALS VORTEX BREAKER										
										7
10 INSULED HORIZ   VERT BY SPHERE		TONS						-		
1 HDS REACTOR	1							_		
2,-0		7/0004.85	-2	140	000		,			7
14 MAT CS CLAD LINING CA 1/8"/ mm										T
15 DES PRESS 2600 PSIG DES TEMP 500 OF										- 1
16 DES PRIESS have DES TEMP OC										
17 X-RAY-SPOT C 100% STRESS REL FAB SHOP FIELD										
IS INTERNALS. BAFFLES ; VORTEX BREAKERS										
20 INSUL CHORIZ CHERT SPHERE CHECT WE		TONS								T
21 FA. 203 HDS RECYCLE GAS CONPR. SUCT. N.O. DRUM V	-							+		7
22 2'-0" 10 5'-0" TT TK MIN. SKINTHT		6500185	4	092	000				-	
MAT GS CLAD LINING CA 1/8"/ mm					7			+	_	$\neg$
									_	
DES PRESS DES TEMP OC										Т
27 X RAY SPOT [] 160% [] STRESS REL [] FAB SHOP [] FIE LO []								=	1	$\neg$
28 INTERNALS: NONE					7			+		7
R										T
30 INSUL [7] HORIZ VERT Y SHPERE ERECT WI		TONS								
TOTAL ACCOUNT					퀴		1	4	4	7
CLIENT AMUCO DUE - GREAT PLAINS GASIF. PLAINT PROD FACT	CI	H M 201			₽¥.		Q 1	NO. 55	7, Acct	
LOCATION BEULANI AUSTY DAKOTA	+=	I AB COST	+		DATE	Fr.P. MY			£	
=		] دره دره		7	> :	-	1			7
										٠.

NREA 200

SKIRT HT	1	ESTIMATE SHEET	SHEET				THE LUMMUS COMPANY Bloomfield	MAUS COMPAN	<u></u>
The Touce Feed Subject   Death   Total   Tot	THE TOURE FEED 500GE DELIAN   THE TOURE FEED 500G   SESTEMP 300 or SIG DESTEMP 300 or SIG DE		DUANTITY	LINS.	MATERIAL	STC	LABOR MH	RUBCONT	2
1   1   1   1   1   1   1   1   1   1	1   1   1   1   1   1   1   1   1   1	DESCRIPTION		COST	COST	3	TOTAL	88	
CS   CLAD   LIMING   CA   Ig'	\$\frac{1}{2}\$   \$\frac{1}{2	IPB TOWER FEED SURGE DRUM	-						
S SOO   SOLO   LINING   Co.   1/6"	C	20'-0" TT TK MIN.	2/00018s	/3	12	0			
\$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$				I				
Solution   Streets rel   Desteup   90° of	S SOO FINE STATE   DAS TEAM OF   SE   INTINÉE MET   BAFELE   VAUTA & BEEALER   SE   VALIA & VALIA & BEEALER   SE	MAT CS CLAD LINING CA 1/8"							
S	STATE   Continue   C	DES PRIESS SOO PSIG DES TEMP 300			_				
10   1000		SS 3M4 S90							
Compared	State	Þ			_	  -			
178 Tours O verit S shere □  18. Storic of the fellox (Red)	188 VINTEX BREAKER  S CLAD LINING CA 1/8"   TONS  S COCONT  S COCONT  S COCONT  S CLAD LINING CA 1/8"   TONS  S CCONT  S COCONT  S CLAD LINING CA 1/8"   TONS  S CCONT  S COCONT  S COCON	VORTEX.							Γ
1000   Very	1000   Very   Sherk	,							
378 Tower over head & Keflux/Red), Drum v.   1   1   1   1   1   1   2   2   3   3	178 Tower average   178	HORIZ UVERTE SPHERE	TONS		_				
S to 10	S - 0   10   20   0   1   1   1   1   2   2   2   2   2   2	JP8 TOWER OVERHEAD REFLUX/PROD.			_				Γ
Material   Worth   2 & x \$1 T/T Water & 200T	MATERIALS   VALUE	5,0, 10 30,0, 11 1K 30,			M				
DES PRESS   C.S. CLAD   LINING   C.S. TEMP   SOO   F. ST. C.S. STEAM   SOO   F. ST. C.S. STEAM   SOO   STEAM   ST	MAST   CS   CLAD   LINNAC   CA   1/8	WITH 2' \$ x 5' T/T WATER			Ţ				
DES PRESS  DES FRESS  DES FRESS  NATIONAL   DESTREAM SOF   DESTEMP   300 ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° °	DES PRESS    DES FREES   DES	CS CLAD LINING CA 1/8"							
NESTLE   SPECIAL   SPECI	NATE   LONG   STRESS RE     LONG   STREME   OC	75 PSIG DESTEMP 300							
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FA 206 NAP. STABLLISE OF CHANN REFLUX BRUM 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	FA 20G   APP   STABLUSE   O'ERHCAD   REFLUX DRUM   1   1   1   1   1   1   1   1   1	INTERNALS: VORTEX							
FA 20G ANP. STABLUSER OVERHIAD REFLUX DRUM 1   1   1   1   1   1   1   1   1   1	FA 206 NAR. STABLLISE OF CRHCAD REFLUX DRUM / 1  24-0" ID 5'-0" TT TK 15' SKIRTHT /500 LBS 4/ 4 500    MAT	=							
State   Sta	### 306 MAP. STABLLISE OVERHEAD REFLUX DRUM / 1  #### 250" ID 5'-0" TT TK 15' SKINTHT / 500 LBS 4/ 4 500  ##################################	INSUL   HORIZ [2] VERT   SPHERE	TONS			1			
### 05 0.0 1	### CS CLAD □LIMING□CA 1/R" mm  ##################################	FA 206 NAP. STABILISER OVERHEAD REFLUX							П
MAT CS CLAD □LINING □CA 1/A"	MAT CS CLAD □LINING □ CA 1/B" mm modes were solded the state of the s	2'-0" ID 5'-0" TT TK 15'			5	0			_
MAT         CS         CLAD □LINING □ CA         1/R         mm         mm <td>MAT         CS         CLAD □LINING □ CA         Image: Note of the content of the content</td> <td>m   mm</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Γ</td>	MAT         CS         CLAD □LINING □ CA         Image: Note of the content	m   mm							Γ
DES PRESS	DES PRESS	CS CLAD LINING CA 1/8"							
NEAV SPOT   100%   STRESS REL   FAB SHOP   FIELD   1  INTERNALS VIRITEX BREAKER  INTERNALS VIRITEX BRE	DESPRESS  NUMBRIL   HORIZ   VERTEX BREAKER  INSUL   HORIZ   VERT   SHFERE    TOTAL THIS PAGE  TOTAL THIS PAG	DES PRESS 150 PSIG DES TEMP 300							
NY SALV SPOT DIOUR DISTRESS REL FABSHOP FIELD DELLE BROWN SHEEKER BROWN FACE  TOTAL THIS PAGE  TOTAL THIS PA	NY STAY SPOT DIOON STRESS REL FABSHOP FIELD STRESS REL FABSHOP FIELD STRESS REL FABSHOP FIELD STRESS REL FABSHOP FIELD STRESS REPRESSIONAL STATES AND STAT	DES PRESS hopeman hopeman DES TEMP							Γ
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INSUL □ HORIZ □ VERT ☑ SHPERE □ ERECT WT TONS TOTAL THIS PAGE  TOTAL THIS PAGE  CLIENT AMUCLO   DUE - GREAT PLAINT GAS/F. PLANT   PROD FACT   LOC.M.H.   BY   HILL   LOB NO. 5571    LOCATION BE: ULANTA DAY OTA   PROD FACT   LOC.M.H.   BY   HILL   LOB NO. 5571    PROJECT TET FUEL FROM CUAL DESIVED FLAVER   LAB COST   REV   O	107AL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT APPLICACY FOR ANY CASH. PLANT PROD FACT  LOCATION BE CLANT ANATH DAY OTA  LOCATION BE CLANT ANATH DAY OTA  PROJECT TET FUEL FROM CAL DEXIVED LIGHTLY MAGERATE  PROJECT TET FUEL FROM CAL DEXIVED LIGHTLY AND	INTERNALS VORTEX							
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LOLE-GREAT PLAINT GASIF, PLAINT PROD FACT LOC.M.H. BY IIIIK JOB NO. 5571  OEC. FROM CAR DERITTO 1141/25 WAGE RATE LAB COST REV 0	LOLE-GREAT PLAINT GASIF, PLAINT PROD FACT LOC M.H. BY HILK JOB NO. 5571  OEC. FKOIN COAL DEXILLO LIGURS MAGERATE LAB COST REV O AND	INSUL [] HORIZ [] VERT [] SHPERE []	TONS						
CULAN NURTY DAKETA  COLAN NURTY DAKETA  WAGE HATE  LOC M.H.  BOY HILK JOB NO. 5571  DATE ILL. 1949  EST NO. 5571	COLANT NORTH DAKOTA DEANT PROD FACT LOC.M.H. BY HILK LOB NO. 5571  COLANT NORTH DAKOTA  COLANT NORTH DAKOTA  COLANT NORTH DAKOTA  COLANT NORTH FOR THE LAB COST REV O AND AND HARBERT	TOTAL THIS PAGE			-				
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FA 207   SA UNIT FELDGAS K.Q. DkUM   MIN. SKINTHT   TONS   TONS   3-6" id   8-0"   TT   TK   MIN. SKINTHT   COOLES   2   8   600	1980   1967   1967   1968   1968   1968   1968   1969	INTERNALS									
FA 207   S5A UAIT FELDGAS K.G. Dr.UAM   1	Fa 207		==				=				
FA 207 PSA UNIT FELDGAS K.O. DFUM  31-6" ID 8/9" TT TR MIN. SKIRTHT    Material Autology   1	Fa 207   \$5 \\ \text{UAIT FELDGOS K.0. Dr'VA }	HORIZ UVERT SPHERE		TONS							
### 3'-6" 10 8'-0" TT TK MIN. SKIRTHT 4000LBS 2 8 000	31-6" 10 8'9" TT TR MIN. SKIRTHT 4000LBS Z 8 600    MAT CS CLAD LIMING CA 1/8"   mm  MAT CS CLAD LIMING CA 1/8"   mm  MAT CS CLAD CLANING CA 1/8"   MAGE RATE  MAT CONTINUE CONTINUE CA 1/4 // 1/	FA 207 PSA UNIT FELDGAS K.O.	1 /								
m ☐ man         m ☐ mat         GES CLAD ☐ LINING ☐ CA 1/8" / mm	Material	3'-6" id $8'-9"$ it Min.	кіят нт	4000LBS	2		00				
MAT         CS         CLAD □LINING□CA         1g"         mm	MAT         CS         CLAD □LINING □CA         1/8"         min	w_]w									
DES PRESS         375         PSIG         DES TEMP         300 °F         PSIG         DES TEMP         300 °F         PSIG         PSIG         DES TEMP         PSIG	DES PRESS	CS CLAD LINING CA 1/8	mm								
DES PRESS  **NAY SPOT   100%   STRESS REL   FAB.SHOP   FIELD    INTERNALS:  INSUL   HORIZ   VERT   SHPERE    **COTAL THIS PAGE  **TOTAL THIS PAGE	DESPRESS  **ANY-SPOT   100%   STRESS REL   FAB SHOP   FIELD	375 PSIG DESTEMP									
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KILLED LIGUEDS WAGE RATE LAB COST REV	Airt D Ligurds WAGE RATE LAB COST AFEV O	BEULAH KURTH DAFOTA				Ò	=	1.18.1	1		<u> </u>
	A172 1081-8 REV 2	Kint D Ligards	VAGE RATE	LAB COST		В		-		-	٦

FELUMMUS ESTIMATE SHEET	SHEET		,		!	ļ	THE LUMMUS COMPANY Bloomfield	AMUS COMPAI	≽
	₽ O O N	OUANTITY	SNIT	MATERIAL	IAL	STOU	LABOR MH	SUBCONTRACT	FRACT
OF SCHILL TON	RFO	EA	COST	COST		UNIT	TOTAL	COST	
1 FA 208 HAKE-UP #2 COMPRESSOR JUGION KO. DRUM	_								
5'-0" 11		1500 LBS	41	4	3				
4 MAT CS CLAD LINING CA 1/8"/					==				
6 DES PRESS 375 PSIG DES TEMP 360 OF									
Agem? DES TEMP									
7 X-RAY-SPOT   100%   STRESS REL   FAB-SHOP   FIELD									
BINTERNALS MIST GUMINATOR (411 SS)									
6									
10 INSUL CHORIZ VERT SPHERE		TONS							
PSA 7711	/								
21.0" ID		SOULBS	4	4	8				
					-				
14 MAT CS CLAD LINING CA 1/2" mm									
40									
16 DES PRESS Lycen 1 DES TEMP OC									
17 X-RAY SPOT [] 100% STRESS REL [] FAB SHOP [] FIELO []									
10 INTERNALS									
20 INSUL   HORIZ   VERT   SPHERE		TONS							
21 FA.									
22 ID TT TK SKIRTHT		rBS			-				
23 m ☐ mm									
24 MAT CLAD DLINING CA / mm									
26 DES PRESS LIPES DES TEMP OC									
27 X-RAY-SPOT [] 100% [] STRESS REL [] FAB-SHOP [] FIELD []				_					
28 INTERNALS					==			_	
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30 INSUL ☐ HORIZ ☐ VERT ☐ SHPERE ☐ ERECT WT		TONS							
l					H				
TOTAL ACCOUNT					=				
CLIENTANOCO/DOE GBENT PAINS SHECKTION AGNT PROD FACT	<u> </u>	LOC. M.H.		<del>-</del>	BY	65	JOB NO.	557/	ACCT
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	EST	ESTIMATE WORKSHEET	WORK	SHEET					
	VIIIV	   	510.1	STO LABOR MH	LOCATION	LING	MATERIAL	SUB	TOTAL COST
DESCRIPTION	AMOUNT	TING	LIND	TOTAL (III	(1) x (2) x (3)	COST	C05T	CONTRACT	M+L+S/
1 GA- 201 A/S HOS FEED PUMP AND SPARE	TWD	, ož	<del></del>						- -
2 GPM 135 SUCT 50 PSIG DISCH 2550 PSIG							· · · · · · · · · · · · · · · · · · ·		
or SpGr. 73 △P 7911 FT		-					28		
<b>5-4</b>								;	
MFR									-
B DRIVER MOTOR 290 HP APM		Š							-
PULSATION DAMPENERS AT SUCTION AND		= =							-
9 INSUL YESONO FRECT WT - PUMP & LIFTLY EH		62 803	····						
/S J1	Two	C C	- <del></del>	-				  -	
11 GPM 260 SUCT IS PSIG DISCH 155 PSIG							2000	1	
or socr 71 AP 456 FT				-				-	
13 MAT'L CASE CI IMPELLER CS									
14 TYPE CENTRIF MFR		=:							
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	<del></del>								
18 INSUL VESTAO	<del></del>	, o				_*	· •	:	
GA - 203 A1S IP	(M)	SZ					<del> </del>		
6 PSIG DISCH	) :				_		15/000		
120 5T						:  !			
IMPELLER						1			
TRIF. MFR							!		
24 DRIVER MOTOR 10 HP RPM		ž				!	- 1		
8 8		- 12				:			
27 INCH YESAMO ERECT WT. PUMP & DRIVER	<b></b>	2001					•	-	1
The state of the s				-					-
TOTAL THIS PAGE	<del></del>								-
TOTAL ACCOUNT GA			-						
31 CLIENT DOE JAMAGO GREAT PLAINS GASIF (CAUT	ESTIMATE	PRODUCTIVITY LOCATION MIE	CTIVITY ON MIT	PRODUCTIVITY FACTOR (2) LOCATION MH	ux DATE	手品	× 5	JOB NO 5	5571 ACCT
33 PROJECT TET FUEL FROM CONL DERIVED LIBUILS		WAGE BATE (3) S/MI	(C) 11V	S/MH	252				
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ST. WWW.S	ESTI	MATEW	ESTIMATE WORKSHEET		1			
Distriction	CNIANTITY	=	STD 1 ABOR MH	LOCATION	TINO	MATERIAL	SUB	TOTAL COST
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GA- 20H A/S TIB TOWER BOTTS. FUMP & STAKE	TWO	ž				15,000		·   -
85		: <del></del> -				)		
A MATT. CASE (S IMPELLER 13 CA								
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		= =	- <u>-</u>	_		<u> </u>		
D INSUL YES/NO ERECT WT - PUMP & I-RIVE IA		10000	<u>.</u> .					
10 GA - 205 A/S WAP STABILISER REFLUX PUMPS	TWO	<del></del>	-				i	
11 GPM 10 SUCT 110 PSIC, DISCH 170 PSIG.						15/000		· ·
12 TENE 180 OF Sp.Gr. 5 1/2 277 17 60 1'SI		<u>.</u>						
13 MATT CASE CI IMPELLEN CS								•
TRUE. MIFT			<u>.</u>	_		<del></del> -		,
15 DRIVER MOTOR 3/H .IF ILI'M		ž						- <del> </del>
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10 Isact 350 resignation 25	3					7		<u>.</u>
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ISE CS IMPELLEN		-=-				:		
RECIP. MFR								
24 DRIVER MOTOR 25 HP HEM		ż					!	
<b>19</b>						!		-
22 INSUL YESINO ERECT WT. PUMP & URIVER		lon: e:		-			-	
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30 TOTAL ACCOUNT GA		<del></del>						
31 CLIENT DOF/ANDIO - GREAT PLAINS HASIF PLANT	TYPE OF	PHODER	PHODER HVITY FACTOR (2)	<u>-</u>		## <del>*</del>	S ON 1S1	5571 ACCT
32 LOCATION PEDLAH NOKTH DAKOTA 33 PROJECT TI FULL FROM COAL DIPINE HADIN		LOCATION MH	LOCATION MH WAGE RATE (3) S/MH	1 7 1		FEB. 1989		CA
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			ESTIMATE SHEET	SHEET					THE LUMMUS COMPANY	SCOMPANY
										Bloomfield
2530	DESCRIPTION			OUA	DUANTITY	TINO	MATERIAL	STD	LABOR MH	SUBCONTRACT
				REO	EA	COST	COST	UNIT	TOTAL	cost
S EECYGE	GAS COMPRESSOR	eessol		2						
120 STM	PSIG/	upa g/c/m²	P2/P1 1.085				300000			
3 MAT'L HANDLED HE RICH	6AS		3.56 MW							
4 SUCT 2350 PSIA	torms TEMP	10 021 al	၁၀							
5 DISCH 2550 PSIA/	Porcm2 Co/Cv	1.37	STGS ONE							
6 MAT CASE \$2 NOL 1/4,5,90% Hy IMPELLER	WPELLER		VOLTS							
7 DRIVER-EM K TURB DIESEL	•	ВНР /	××							
BINCL GEAR LUBE & SEAL DINTERCOOLER	COOLER COND	_]QN(								
9 TYPE CENT   RECIP & ROTARY   SCREW	SCREW									
10 INSUL [		ERECT. WT CO	COMPR + DRIVE		TONS					
11 GB 202 A/S NAKE-UP IL. C	COMPRESSOR	PACE	se.	7						
Ø STM	PSIG/	Mp/cm2	P2/P1 1.9/59	*		1,3	2,000 000			
13 MAT'L HANDLED			2.02 MW	-						
14 SUCT 3 40 PSIA!	kg/cm2 TEMP	10 S 2 a	၁၀							
15 DISCH 2520 PSIA	horem2 Co/Cv	1.4	srgs 3							
c 5	IMPELLER	<b>CS</b>	VOLTS							
17 DRIVER EM ST TURB   DIESEL	2.870 BHP	/ 6	kW							
18 INCL GEAR [] LUBE & SEAL THINTERCOOLER CONDE	ERCOOLER S	COND K								
19 TYPE CENT   RECIP TO ROTARY   SCREW	] SCREW []									
20 INSUL []		ERECT WT CON	WT COMPR + DRIVE		TONS					
21 GB 203 A/S PSA TAIL GAS	S COMPRESSOR		PACKAGE	7						
22 CAP SCFM 9080 STM	bsic/	ł	HOJEM 2 P2/P1 2.66/579CE	<b>Y</b>			2,800 000			
23 MAT'L HANDLED			19.25 MW	_						
24 SUCT 20 PSIA/	torms TEMP	10 OF	၁ <sub>၀</sub>							
S PSIA/	Mens Co/Cv	1.25	stes 3							
=	IMPELLEM	CS CS	VOLTS KW							
27 DRIVER EM 🛜 TURO 🗌 DIESEL 📋	4000 BHP	/41	kW							
28 INCL. GEAR [] LUBE & SEAL K INTERCOOLER (COND)	ERCOOLER\$	<b>⊠</b> a <b>n</b> oo								
29 TYPE CENT [] RECIP [X] ROTARY [] SCRE	SCREW []									
30 INSUL []		ERECT WT CON	COMPR + DRIVE		TONS					
TOTAL THIS PAGE										
TOTAL ACCOUNT										
CLIENT DOE / AMOCO GREAT PLAINS GASTECATION 174117	NS GASTEC	ATTEN 174M	Z PROU FACT	<u></u>	LOC M H		ВУ	65	S ON BOL	S7/ ACCT
LOCATION BELIEFF NORTH DAKETA	TY DAKOT			+-	-	-	DATE	8-16-1	) EST	GB CB
PROJECT JET FLYEL PROM COM DERIVED	MI DERING	5917011 9	WAGE RATE		I AB COST		HEV	,		

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Continue	SLUMMUS	SHEET			THEL	UMMUS CON	PANY
Fording that the part of the		OUANTITY	-	AATERIAL	STD LABOR N	F	ONTRAC
Ph-20    Par Rakage will to rusely the rake ut to	MOI LIBORIO			COST	$\vdash$	T	OST
Freedom tradelium   13.19 moly   15.60   15.	PA-201 PSA PACKAGE UNIT TO PURIFY THE MAKE UP				Ц		_
Tredage conflicion   12.61						1	V
Hand   18.45	Fredago conditions		9	200		7.50	900
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CLIENT: DOE

PROJECT: 5571

LOCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

21-Apr-89

03:05 PM

EQUIPMENT

# PCS. \$ EOUIP.

1 COMM

\$ COMM

**HEATERS** TOWERS INTERNALS REACTORS EXCHANGERS AIR COOLERS **VESSELS** TANKS **FILTERS PUMPS COMPRESSORS** PACKAGE UNITS

1	\$60	100%	\$60
		110%	
1	\$560	70%	\$392
2	\$85	100%	\$85
1	\$70	100%	\$70
3	\$85	120%	\$102
2	\$100	100%	\$100
2	\$400	808	\$320
12	\$1,360		\$1,129

SUMMARY

EQUIPMENT

\$1,360

COMMODITIES

TOTAL

\$1,129

LABOR

\$813 (10% EQUIP,60% COMM)

INDIRECTS

\$813 (100% LABOR)

ENGINEERING

\$720 (1000/PC X \$60)

SUBTOTAL

\$4,836

CONTINGENCY

\$967 (20%)

TOTAL

\$5,803

)

SUBCONTRACT COST Acct 2 THE LUMBIUS COMPANY 1155 Hearn/lefe EST NO. STD LABOR MH TOTAL DATE FEB 1983 REV. 0 5 6000 MATERIAL COST COST COST LAB. COST TONS TOMS LOC. M.H. TONS ¥ QUANTITY AREA 300 **ESTIMATE SHEET** REO WAGE RATE PROD, FACT <u>د ۽</u> 8 ERECT. WT . ERECT. WT ERECTIVIT å TOTAL TOTAL TOTAL 1.30 CLIENT AMUSO / DOLE - GREAT PLAINS GASIF. PLANT MOCATION BEULAH, NESTH DALOTA
MOJECT JET FUEL FRUIT COAL DESIVED LIQUIDS N S 8 PSIG 286 8 6 **8 200**€ HCR FEED HEATER 2000 **3** 8 **3** 8 3 8 DESCRIPTION 5 Ca - 1/2 Mo CYL. VERTICAL NO PREHEATER DECONOMIZER PREHEATER DECONOMIZER PREHEATER DECONCAUZER 2250 PBG 750 PF 3 .30 3 3 5000 PERC \* TOTAL THIS PAGE ASSONSED DUTY: TOTAL ACCOUNT 12 ABSORBED DUTY: ABSORBED DUTY. MAT TUBES 17 MAT TUBES MAT TUBES 28 DES PRESE SE DES PRESS DES TEMP DES PRESS DES TEMP DES TEMP 22 and 0 and 15 470 775 4 178 TAPE 34 2 Ì

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Comparison	DES PRESS kg/Lm2 DES TEMP							
STATE   STAT	٠							
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	TALYST BEDS (3-6", 7'4"							
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ě	SHELL SIDE CA. 78"	- mar	TUBE SIDE CA	U.S.						
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2	SHELL SIDE CA	/ mm	TUBE SIDE C.A.	e E			_			
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FINNED   SOFTEA	FINE		EASSE	MBLED															
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POCE - GREAT PLANK GAISTE. TEAM PROD FACT LOC M.H. BY HILK LOB NO. 5571	POCE -GREAT PLANK GAISTE. TEAM PROD FACT LOC M.H. BY HILK LOB NO. 5571  OEL FROM CONLIN CALL IN CALL I										TONSEA								
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	H	PROJECT JET	FUE	Fresh	ことの	7 7 2	71. 71.0 71. 71.0	20105	T	111	LAB COST			1	ے اد				

C AREA 300

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	20	QUANTITY	SNIT	MATERIAL	141	STO	STD LABOR MH	opens	BUSCONTRACT
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MESS 75 PSIG DESTEMP 400						Ì	-		-
								-	_
T   100%   STRESS REL   FAB-SHOP									
BINTERNALS VORTEX BREAKER								4	
									_
10 INSUL   HORIZ   VERT   SPHERE		TONS			H			4	
HCR REACIDE EFFLUENT HY/LT SEPAPAT	-								
H-04 10 12-0" TT TK		3000 LBS	2	100	000				
14 MAT (S CLAD TINING CA 1/8" / mm								-	
PRESS								4	
16 DES PRESS LOCK TEMP OC							-	-	
T   100%   STRESS REL   FAB-SHOP								4	
INTERNALS. DIVIDING BAFFLE; VORTEX BICAKER								-	
						1	-	+	
20 INSUL ☐ HORIZ ☐ VERT [ST SPHERE ☐ ERECT. WT.		TONS			1			+	$\frac{1}{1}$
11 IN 303 HCP DENIUE LOMPRESSOR KO. DRUH							1	+	
2 2 -61 10 8 -01 тт тк sкіятнт		ADOC 188	2.20	0	000			+	
								-	1
20 MAT C\$ CLAD LINING CA 1/P"   mm							$\frac{1}{1}$	-	1
25 DES PHESS 1900 PSIG DES TEMP 200 OF								-	1
26 DES PRESS Lace Lace OC							+	+	$\frac{1}{1}$
27 X.RAY.SPOT   100%   STRESS REL   FAB.SHOP   FIELD					1			1	1
28 INTERNALS:							+	+	1
2								-	1
30 INSUL [] HORIZ DA VERT SHPERE [] ERECT. WT		TONS						4	4
TOTAL THIS PAGE							+	+	$\downarrow$
TOTAL ACCOUNT					1		-	4	1
1000 DUE-GREAT PLAIN		LOC. M.H.				- 1	HIIK JOB NO.	1255	Agg
MOGATION BEULAH NIZTH DAKOTA	+=	LAB COST	_		DATE REV	FF 6 1987			<b>4</b>
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AMOUNT UNIT TO ABOUT UNIT MATERIAL  AMOUNT INTO TO THE COST (19.1)  No.		ESTIMATE	ESTIMATE WORKSHEET					
SO		CHIANTITY	STD 1 ABOR MH	=			SUB	TOTAL COST
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\$60   \$810   \$10	GA- 301 AS HOR FEED PUMP & SPAR							· i
CASE	GPM 60 SUCT 50 PSIG DISCH 1850					000/00/		-
VER MOTOR   105 HP RPW   111	MATT CASE OF SPORTS SOLD TO 1800				_			•
No.	MFR			.~.				i .
SUCT	1 - 105.	ž			-			- • -
SUCT   PSIC   DISCH   PSIL.   PSIL.					-	_		
SUCT   PSSF   DISCH   D	ERECT WT. PUMP & HRIVE	7		-		_	_	
SUCT   PSIC   DISCH   D		<u>.</u>		-			: _	ļ -
CASE     MAPILITIA	SUCT PSIG DISCH		-	· —				
CASE	TEMP OF SpGr AP 1 T							
	MAT'L CASE			<del>-</del>		-	_	
ULYESMO ERECT WITPUMP A DILIVIA  SUCT SUCT SUCT FILE FSIG DISCU 1 GBI.  THE STUS  WER  HIP HIM N.  TAL THIS PAGE  TAL ACCOUNT GA  TAL THIS PAGE  TAL ACCOUNT GA  TAL THIS PAGE  TAL ACCOUNT GA  THE TIME OF SUCT TAL THIS PAGE  TAL THIS PAGE  TAL THIS PAGE TAL ACCOUNT TO SUCT TO SU	TYPE			· ·=-	-			
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	INTERIOR TO LANGUE COMPANY OF THE PROPERTY OF				-			<u>-i</u> -
P OF SUCT FIG DISCH (SH.)  T. CASE   IMPELLEN    T. CASE   IMPELLE	Tresmo		; ; ; ;	-	-			
CASE  MEN  HIP HTM  THIS PAGE  AL ACCOUNT  GAS  HIP HTM  THIS PAGE  AL ACCOUNT  GAS  HIP HTM  HTM  HTM  HTM  HTM  HTM  HTM  HTM	SUCT PSIG DISCH		- · ·				<del></del>	_
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TOTAL ACCOUNT GA TOTAL CARLE PLANT ITTEOF PHODUR HILLY THE ITTE								
CLIENT TOF AMONG - CREAT PLANT CARLE PLANT INTO PHODUR INITY FACTOR (2)	TOTAL THIS PAGE TOTAL ACCOUNT							_
ALL COURS OF THE C	CLIENT DOF/AMOGO - GREAT PLAINS GASIF. PLANT	TYPE OF PRODU	K HVIIY LACTOR 12	- 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	美	+-	HOE	FE7! ACCT
LOCATION BEULAH NORTH DAKOTA 1959 151	LOCATION BEULAH NORTH DAKOTA		ION MII	DATE	: .		}	GA.
IVED LIZUIDS WAGE HATE BESTAIN	PROJECT THE FUEL FROM COAL DERIN	WAC,E	RATE (3) S/MH	?	2 .			

Area 300

				3								
			EST	ESTIMATE WORKSHEET	WORK	SHEET						
Bearfield		-		=							5	
DESCRIPTION	MOLL		CUANTITY	<u> </u>	STD. L	STD. LABOR MH	LABOR COST		MATERIAL		CONTRACT	TOTAL COST
			AMOUNT	MEAS.	T S	TOTAL (1)	$(1) \times (2) \times (3)$	cost	COST		COST	M+1.+5/C
1 GB - 301 A/S HOR RECYCLE	LE GAS COMPRESSOR/SPARE	R /STARE	2	Š								
2 CAP. ACTUAL SUCTION CFM	182.1	,							400	000		
3 MATERIAL HANDLED Hy. RICH 6/15 (90.8 MUL!)		4.10 MW										
4 SUCT.   650 PSIA TEMP	i _											
1850	1.38 STGS	ONE							_			
	_											
TYPE RECUP. MER	RPM					_					 	
B INCL: Geer Lub & Seel	Intercool Cond	2							_		-	
10												
11 DRIVER MOTOR	344 HP RPM			Š								
12 VOLTAGE STEAM-PSIG		700										
13												
14 INSUL YES/NO ERECT WT	COMPR +	DR -		tons ea	_						_	
16 Ge				SO.					L			
16 CAP. ACTUAL SUCTION CFM												
17 MATERIAL HANDLED		MW										
16 SUCT. PSIA TEM	ENE OF P2/P1											
19 DISCH. PSIA CA/CV	p/Cv STGS											
20 MAT'L: CASE	IMPELLER											
21 TYPE MFR	RPM											
Gear Lub 8	Intercool Cond	<b>1</b>		-								
23												
7												
26 DRIVER	HP RPM			ò	-							
28 VOLTAGE STEAM-PSIG	IG.	100										
π												
28 INSUL YES/NO ERECT WT	COMPR +	DR -		tons ee.								
29 TOTAL THIS PAGE												
30 TOTAL ACCOUNT GB												
CLIENT DOE/IMMOG - 6		r. PLNNT	TYPE OF ESTIMATE	PRODUC	TIVITY	PRODUCTIVITY FACTOR (2)	ВУ	开	조		JOB NO. 5	5571 ACCT
32 LOCATION BENEATH NORTH DAKOTA		Canada		LOCATION MH	LOCATION MH	e Mari	DATI	11.6	1983			89
_				1	2	A min	34		2			
												4127 OC 20

CLIENT: DOE

PROJECT: 5571

OCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

22-Mar-89

08:27 AM

EQUIPMENT

# PCS. \$ EQUIP.

\* COMM

\$ COMM

HEATERS
TOWERS
INTERNALS
REACTORS
EXCHANGERS
AIR COOLERS
VESSELS
TANKS

TANKS FILTERS PUMPS

COMPRESSORS
PACKAGE UNITS

TOTAL

<del></del>		<del></del>	
<del></del>			
			<del></del>
4	\$105	120	\$126
4	\$48	120	\$58
		<del></del>	
8	\$153		\$184

# SUMMARY

**EQUIPMENT** 

\$153

COMMODITIES

\$184

LABOR

\$125 (10% EQUIP,60% COMM)

INDIRECTS

\$125 (100% LABOR)

**ENGINEERING** 

\$480 (1000/PC X \$60)

SUBTOTAL

\$1,068

CONTINGENCY

\$214 (20%)

TOTAL

\$1,281

**ESCALATION** 

\$128

10%

TOTAL

\$1,409

A172 1081-8 REV. 2

CASE I MAXIMUM JP-4	, V 3 0 V						
ESTIMAT	SHEET					THE LUMMUS COMPANY	SCOMPANY
							Bloomfield
DESCRIPTION	9	OUANTITY	COST	MATERIAL	·STC	STD LABOR IMH	SUBCONTRACT
1FA 501 CATALYST OIL DRUM		5		-	5	1014	isos
9 -, 1		4000 LBS	B	17/			
3 m [ mm [		ſ					
AMAT CS CLAD LINING CA 1/8"   mm							
PSIG DES TEMP 650							
Ape DES TEMP				-			
7 X.RAY-SPOT   100%   STRESS REL   FAB-SHOP   FIELD							
• INTERNALS:				-			
L S HORIZ E		TONS		-			
17.44	/			Spec			
4-0		res					T
13 m C mm C				-			
14 MAT C S CLAD LINING CA 1/8"   mm							T
15 DES PRESS 35 PSIG DES TEMP / 50 PF				-			
16 DES PRESS LIGHT OC	-						
S REL []FAB.SHOP []							
18 INTERNALS: CONE BOTTOM,	-						
•				_			
INSUL   HORIZ	- 	TONS					
FA. 503 CATAL	-						I
- 1		17000 LBS	7,	68000			
	<del> </del>	*					
Cr 1/10 cuo				-			
2600	_						
DES PRESS Liptural DES TEMP				-			
77 X.RAY.SPOT [ ] 100% [ STRESS REL  FAB.SHOP ] FIELD							
28 INTERNALS:							
	_						
30 INSUL SE HORIZ UVERT SHPERE C	-	TONS					T
TOTAL THIS PAGE	_					-	
CLIENT AMOCO /DOE - GREAT PLAIN'S GASIF. PLAINT MOD FACT	_	LOC. M.H.		۵	1//(	NO. CA	7) ACCT
PROJECT TET EVEC FROM COAL DESIGN OF THE MACE RATE		1982	$oldsymbol{\perp}$	DATE	3	Z EST	FA
114.00.00		Lau cust		l REV	0		

A122 1081-8 RFV. 2

7 04	<b>\</b>								
T WALLEY T	REA								
ESTIMATE SHEET	SHEET						THE LUN	THE LUMMUS COMPANY	PANY
DESCRIPTION	QUANTITY	<u>}</u>	UNIT	MATERIAL	-  -  -	ors	STD LABOR MH	20112	CI INCONTRACT
	REO	Ę	COST	COST	<u></u>	LINS	TOTAL	T T	COST
FA SO4 SPENT CATALYST VESSEL					<del> -</del>		-		L
2 5-0 10 /5'-0" TT TK 30-0 SKIRT HT		เคร		200	8			-	
C S CLAD LINING CA "4"									
- B MC 1 - 5 - MC NAC					==	_	-		
DES PRESS  DES TEMP  OC							-		
TIOON STRESS REL SEASHOP				-	-		-		$\downarrow$
CONE BOTTOM							-		_
							-		_
THE PRINCIPLE SPHENE SPHENE STATES SPHENE SPHENE		TONS		-	=				
12 IN SKIRTHT		rBS			-	-	-		
							-	-	
14 MAT CLAD LINHING CA					-	<del> </del>	-	-	
					+			-	
16 DES PRESS DES TEMP OC				+	-	$\dagger$	+	+	$\prod$
O 100% STRESS REL OFABSHOP				$\vdash$	-	T	-	-	
18 INTERNALS:			<del> </del>	-	F	+		-	
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WINSUL HORIZ VERT SPHERE		TONS							
F.A.						<del> </del>	_		
		1.85			-	$\vdash$	-		
m () m					-	$\vdash$			
CLAD ULMWGU CA					=	-	-		
CES THESE	-						-		
DES THESS						-			
						-	-		
20 INTERNALS:			-	-	-	$\vdash$	-	-	
		-	-	-	-	$\vdash$	-	-	
30 INSUL  HORIZ VERT SHPERE		TONS			-	$\vdash$	-	-	
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TOTAL ACCOUNT		-		650	08	+	-		Ī
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===	1			à	DATE ///	18/22	EST TO.	55 //	FA
PROJECT JET FUEL FROM COAL DERIVED LIYUIDS WAGE RATE		LAB. COST		REV.		0			

/ かくせつ	MAXIMUM	3	4	500 A	AREA						
E SLUMMUS	IMUS			ESTIMATE SHEET	SHEET					THE LUMMA	THE LUMMUS COMPANY
		No contractions			VNO.	DUANTITY	CNIT	MATERIAL	216	STO LABOR MH	SUBCONTRAC
		DESCRIPTION			REO	EA	COST	COST	CRIT	TOTAL	COST
1 GA 50/4/5	CAT. 7	TRANSFER	DUMIP		2						-
2 GPM / O	SUCT	PSIG DISCH	PSI TEMP	600				40000			
3 m <sup>3</sup> M	SUCT	Maren 2 DISCH	Agent TEMP	OC OK							
SP-GR	ΔP		184 0092	STGS							-
9	40	E	Por Par	RPM							
6 MAT CASE S	S	IMPELLER		25 HP	_					_	
DRIVE EM - ET TL	TURB   DIESEL	EL O OTHER									
8 TYPE CENT -   R	RECIP SO PROP	OTHERS [	API   ANSI								
IV											
10 INGUL 🐼			ERECT, WT PUMP & DRIVER	P & DRIVER		TONS					
11 GA 502485	CATA	TALYST OIL	9 Mincl		2			8			
12 GPM 10	SUCT	PSIG DISCH	PSI TEMP	NP 2000 or							
13 m³/h	SUCT	Agem 2 DISCH	Agicm2 TEMP					-			
14 SP.GR	40	FT	150 PSI	\$TGS							
15	ΔP	£	bycm2	MPM							
16 MAT CASE C	S	IMPELLER		3 HP							
	TURB   DIESEL	L O OTHER		kW							
_	RECIP   PROP	OTHERS [	API - ANSI								
19 MECH. SEAL X											1
20 INSULES			ERECT, WT. PUMP	PUMP & DRIVER		TONS					
71 GA											
22 GPM	SUCT	PSIG DISCH		AP OF							
23 m³m	SUCT	Potent DISCH	Agem 2 TEMP	AP OC							
2 Seca	٥٥	н	PSI	STGS							
34	٥	E	kg/cm2	HPM				_		•	
28 MAT. CASE		IMPELLER		HP				_			
77 DRIVE EM - TU	TURB   DIESEL	L O OTHER		N.Y	-						
28 TYPE CENT - R	RECIP   PROP	P□ OTHERS□	API   ANSI								
29 MECH. SEAL											
30 INSUL			ERECT. WT. PUMP & DRIVER	& DRIVER		TONS				_	
TOTAL THIS PAGE											
TOTAL ACCOUNT								10000			
CLIENT AILOCO	DOE	REAT PLAINS GL	GASIF. PLHIN	PROD FACT	1	LOC. M.H.		٨	11/11	108 NO. 557	<u>`</u>
1 140		FROM COAL DE	DC SIVED LOWIN	WAGE RATE	W	LAB. COST		REV.	ग्रे	_	₹5

# 6.0 EQUIPMENT DATA AND ESTIMATE SHEETS

6.2 Naphtha Stream

6.2.1 AREA 600

6.2.2 AREA 700

CLIENT: DOE

PROJECT: 5571

OCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

22-Mar-89

08:57 AM

EQUIPMENT

PCS. \$ BOUIP.

**\$ COMM** 

\$ COMM

HEATERS
TOWERS
INTERNALS
REACTORS
EXCHANGERS
AIR COOLERS
VESSELS
TANKS
FILTERS
FUMPS
COMPRESSORS
PACKAGE UNITS

	T T		
2	\$48	140%	\$67
	\$8		
1	\$125	85%	\$106
9	\$123	100\$	\$123
7	\$89	100%	\$89
16	\$68	100	\$68
4	\$230	60\$	\$138
39	\$691		\$591

#### SUMMARY

EQUIPMENT

\$691

COMMODITIES

TOTAL

\$591

LABOR

\$424 (10% EQUIP,60% COMM)

INDIRECTS

\$424 (100% LABOR)

**ENGINEERING** 

\$1,872 (800/PC X \$60)

SUBTOTAL

\$4,002

CONTINGENCY

\$800 (20%)

TOTAL

\$4,803

ESCALATION

\$600

12.5%

TOTAL

\$5,403

GOOAREA

SUBCONTRAC ACCT A 144 t POUT PET A THE LUMMUS COMPANY COST 1255 Bloomfield FST NO. STD LABOR MH TOTAL DATE 4 JANES ENS AFV O 2/200 /pao MATERIAL COST Α UNIT 5 3, Par LBS LBS LAB COST LBS I OC MH TONS TONS TONS 3 ¥ DUANTITY **ESTIMATE SHEET** REO PROJECT JET FUEL FRUIT COAD WALL D. 14 WIDS WAGE BATE PROD FACT PSIG DES TEMP 325 OF E ¿ 325% Ę SKIRT HT SKIRT HT ပူ ပ္ SHIRT HT IBS FRECT WT Ibs ERFCT WT THE EMPECT WIT CA X4. PSIG DES TEMP PSIG DES TEMP April DES TEMP torent DES TEMP CLIENT AMOCO/POE-GREAT PLAINS GASIF. PLANT ADT NAPHTHE STABILIZER といろ ა X-RAY-SPOT | 100% | STRESS REL | FAB-SHOP | FIELD | X RAY SPOT [] 100% [] STRESS REL [] FAB.SHOP [] FIELD [] X RAY SPOT [] 100% | STRESS REL [] FAB SHOP [ FIELD [ ¥ ¥ LOCATION BEULAH, NORTH DAKOTA CLAD CLINING CLAD [ ] LINING [ ] INTERNALS TRAYS INSTALLED SHOP & FIELD CLAD [] LINING 18 INTERNALS TRAYS-INSTALLED SHOP SFIELD 28 INTERNALS' TRAYS-INSTALLED SHOP TIELD DISTIC. CASE 7 MAX PROFIT 11 'D-'CE ۲ F DESCRIPTION 32-0" ths 08. **4.** Ps 08. NAPHTHA F SLUMMUS 0 9 5 3 - 40 . V DA: TOTAL THIS PAGE ٥ TOTAL ACCOUNT MAT CS 209 40 25 DES PRESS DES PRESS 13 mm | m | E1 DES PRESS 16 DES PRESS 109 va DES PRESS ] www [] w 28 DES PRESS INSOL K INSUL X 30 INSUL MAT M 5 17 2 23 12

			_	ESTIMATE SHEET	SHEET					THE LUMML	THE LUMMUS COMPANY Bloomfield	
					180	OUANTITY	TINIT	MATERIAL	F	STD LABOR MH	SURCONTRACT	\ V
	DESCR	DESCRIPTION			REO	FA	COST	ट०इर	5	TOTAL	COST	
108 GOI NAPHTHP	DISTILL.	ILL. TRAY.	<u> </u>									
-	٩i٥	D1A m [ ] mm [	MAT	NO PASSES								
July C	2.6"		52	7	8		150-	1500	2			
4 8								-	+			T
•												П
	_											
9 OTHER INTERNALS												
01				FRECT WT		TONS				L		
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5												T
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01												7
19 OTHER INTERNALS												П
20				ERFCT WT		TONS						$\neg$
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22 TVPE	Vã Oi V	DIA . DIA m [ ] mm [ ]	MAT	NO PASSES								T
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29 OTHER INTERNALS												
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TOTAL THIS PAGE												
TOTAL ACCOUNT								+	1		+	1
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	NerTH	DAKOTA		WACE BATE	-	TAR COST		8 6			T	80
PROJECT_ET FULL FRUIT COAL DE	27 ///2	WE DE VII CIVE.	1150 2100103	=		11 52.0		MI MIL	2		1	٦

CASE 7 MAX PROFIT

600 AREH

		QUANTITY	<u>}</u>	STD	LABOR MH	LOCATION	CNIT	MATERIAL	SUB	TOTAL COST
DESCRIPTION	<u> </u>	AMOUNT	MEAS	CNIT	TOTAL (1)	(1) x (2) x (3)		COST	COST	+ L + M
TREATER REA	Sall		Š							
4-0" in 16-0" T/T H	SKIRT HT	23000	lbs. ●				5,8	125000	0	
MATI C - "ZMCLAD CA "	4/							1		
DES PRESS \$70 PSIG DES TEMP 525	# V									
STRESS REL FABSH	OP/FIELD					_				
ONTAL VERTICAL										
INTERNALS (atalket, Bod Suppo	oort									
INBUL - (FES MO	ERECT WT-		toms ea							
26			No.			_				
ID T/T th SKI	SKIRTHT		fbs. œ							
MAT'L CLAD CA										
DES PRESS PSIG DES TEMP	30									
X-RAY STRESS REL FAB SHO	OP/FIELD									
HORIZONTAL VERTICAL										
INTERNALS					-	-				
					i					
INSUL - YES/NO ERECT	CT WT=		toms see.							
TOTAL THIS PAGE										
TOTAL ACCOUNT DC										
	F. PLAIM	TYPE OF	PRODU	CTIVITY	PRODUCTIVITY FACTOR (2)	8	7 <i>((1)</i>	,	80r	CA, ACCT
N 1 .	ļ	COLLEGE	LOCAT	LOCATION MH		0		4 JAN 88		٦l
	- Varin''						,		_	

	I WILLIAMS			ESTIMATE SHEET	משנני						8	undierig
					S.	QUANTITY	THE	MATERIAL	!V	STOLA	STD LABOR MH.	SUBCONTRAC
		DESCRIPTION			REO	TOTAL	cost	COST		COORT	TOTAL	C057
th. 60/	NAPHTHA	DISTIK.	COLN RE801	LER								
SIZE-IN DAL		m 0/L	the same	leu l					=	-		
10 SHELL/SERV.	.x.	SOFTISHELL TO	OC TOTAL SOFT	JUD ISEAN		SOFT	10-	130	8	_		
IO SHELL/SERV.	₹.	m <sup>2</sup> /SHELL	TOTAL m2	/SE HV		- m						
	SHELL SIDE C.A.	.A.	TUBE SIDE C.A.									
AAT.	50		65									
DES PRIESS	Sc 33G	23	147) 1516	C	-							
DES TEMP	l.		360 %	န								
TUBES DIA	SA MIN	CA MIN O AV O WELDED	SMLS CXP	DINION	_							
WE ENDS: N	TUBE ENDS: WELDED   NO. TUBES	Ш		ERECT. WT		TOMSEA						
EA. 407	NAPHTHA	15716.	4. CON	DENSER	/							
12 SIZE IN DA		THE DA	TYPE H	נוע								
NO SHELL/SERV.	- A.	٥	40) TOTAL SOFT	WD rsenv		SOFT	-00	D	22			
NO SHELL/SERV.	₩.	ŀ	TOTAL m2	SERV		2 <sup>CM</sup>						
	SHELL SIDE C.A.	.A. mm	TUBE SIDE C.A.	The state of the s	-							
MAT	CS		CS									
DES PRESS	75 msic	£\$	/30 msic/	C					_			
DES TEMP	100 061		120 %	<b>၁</b> ၀								
TUBES DIA	CA MIN	O AV O WELDED	C SMLS C EXP JOHNT	HNT []						-		
UBE ENDS V	VELDED DINO	U	ະທູ 🔀	ERECT. WT		TOWS EA			=	1	1	
4. 603	en 603 ADT REACTOR	76	IEFFL. EXCH		1				+	+	1	
SIZE-IN. DIL		mm D/L	TYPE A	Eu					-	4	1	
NO SHELL/SERV.	7	SOFTISHELL 325	TOTAL SOFT	650 ISERV		SOFT	-52	13	000			
NO SHELLISERY.	RV.	m <sup>2</sup> /SHELL	TOTAL m <sup>2</sup>	SERV		- w				1	1	
	SHELL SIDE C.A.	C.A. mm	TUBE SIDE C.A.						+	-	-	
MAT	C-14MD	0	C-1440						+	+	$\frac{1}{1}$	
DES PRESS	\$70 msmg	Carried /	870 msic/	500 pm						1	1	
DES TEMP	525 00		475 00/	ာ့					-	1		
TUBES DIA	GA MIN	CA MIN C AV WELDED	SMLS [] EXP	JOHNT					-			
TUBE FNDS	TUBE ENDS WELDED CINO, TUBES	Ш	SUL ES	FRECT WT		TONSEA						
TOTAL THIS PAGE	PAGE				Γ							
TOTAL ACCOUNT	XURT				П				=	1	4	
CLIENT AMOCO	ľ	DOE-GREAT PLAINS CASI	ASIF. PLANT	PROD. FACT	-	LOC M.H.			.7/// AB	1	JOB 100.	5571 AOCT
LOCATION		14	PAKOTA		+	=	$\downarrow$	Ī	DATE 4	JAN 66	Ì	1
				MANGE GATE	_		_					

SOFT COST LOST LOST LOST LOST LOST LOST LOST L									THE LUMBER	COMPANY
	I T		ES	TIMATE SHI	EET				8	mete
10   10   10   10   10   10   10   10		MUS		=	QUANTITY	125	MATERIAL	9110	5	SUBCONTRAC
10   10   10   10   10   10   10   10		DESCRIPTION	3	=	L	COST	cost	THAT	TOTAL	2021
197 H. D. 197 H	4.7	Princeral	740 277							
00 SHILLISTON.  00 SHILLISTON	1	ALL DA	TYPE A				_		1	1
SELLISENY.  SELLIS	O SHELL SERV		C) TOTAL SOFT	2) NSE PRI	20.	2	_			1
### 100 SOL SETTING CA   mm   Tome Side Ca   mm   ### 100 FOR   mm   Tome Side Ca   mm   ### 100 FOR   mm   Tome Side Ca   mm   Tome Side Ca   mm   ### 100 FOR   mm   Tome Ca   mm   Tome Ca   mm   Tome Side Ca   mm   Tome Side Ca   mm   Tome Ca	O CHELL ASERV.	7	1	/SE FIV	E	5				1
DES NELS \$ 7.0 C = 1/2 M/S	196	-	L	mu			+	+		-
Cost steels   170 Find   175 Fi		M°					+			+
1063 FEED   4/5 mt   1000 FEED   2014   1000 FOT   1	+		4.35	ا دس بخوه			+	1		1
THORSE DIA CA MAN CAN METODO SALED ENFORM TO STATE OF ST	7		775	၁				+	-	
19.00 SHELLSERV. SO THE SILE CATCH HAVE GET A STAND SO THE SILE CATCH HAVE GET A STAN		OAY DAMA Y	O SMLS C) EXP	ים ו		<u> </u>	+	+	+	
### SO STABLL-ACAT FEED EXCHANGEL	THE EMOS WELDS		23.5		TONS	7	1	+	-	1
### STEELING TO THE STEELING	0 000	17	Ĺ	<i>γ</i>		4		+		+
### 100 SHELLSERW. ####################################		1 2	TYPE A.	72		<u> </u>	1	+		+
MAT	A ener I REBY	SO FT/SHELL	١.	SISERV	30.	N	Y		+	+
MAT  SHELL SIDE C.A.  MAT  SHELL SIDE C.A.  MAT  STATE	A SHELL SERV	m246HELL		SERV	-		-	1		-
NESS PRESS 970 PSIG	35	-	TUBE SIDE C	um /		-	+	+	+	
SESTINGE   270 of   SEC   S			CS				\ 	+	+	<del> </del>
VESTERM   270 %   VESTERM   VESTE	╁		OL8	77.		-	1	+	<u> </u>	+
THE ENDS WEIDED   SALS   EMPECT WT TONSEA TOWERS DIA GAMM   AV   WEIDED   SALS   EMPECT WT TONSEA TOWERS   MISSUE   MIS	1		380 °F/	1	+	+	+	+	+	-
THE ENDS WELDED DUO THESE DINOTHESE	TUBES DIA	OV	SMLS C EXP. JOH			+	+	+	-	-
STEFFIN DIL   STEFFIL	TUBE ENDS WELD		2	5	10MS	1	+	+		-
### DATE   March   1996   1974   1975   197	14 606 RE	ACTUR GFF1	N	7		+	+	+		
### SPELLSENV. ####################################	ŀ	mm D/L	TVPE	1/		1	0	+	-	-
### TUBE SIDE CA.   mm TUBE SID	NO SHELL/SERV.	SOFT/SWELL	350	SO ISERV	8	5		1	-	-
## 1   Section   Fig.	NO SHELLISENV.	١.		SERV		1	+	+	1	<del> </del>
DESTRIES 130 PSIG LOS SIGN LOS CONTROLS	3		TUBE SIDE C	/		1	+	+	+	+
DESTRINGS   30 PSIG   100 PSIG						+	+	+	1	+
DESTRING 120 of a control of 250 of control of the following the followi	25 900 5 90	3.1C	078	الاستينية			+	+	1	
TUBES: DIA GA NAN CIALED AVO WELDED SMLS CIRECT WT TONS EA TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOS SPECE OF STATE OF S	THE STEEP	25	250	၁၀		+	+	+	+	+
TUBE ENDS WELDED CINO. TUBES   INSUL BD   ERECT WT TONS EA    TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOS & DOE - GREAT PLAINS CASIF. PLANT   PROD FACT   LOC M.H.   DOATE 4 JANSE    LOCATION BEULAH, NORTH DAKOTA    LOCATION BEULAH, NORTH BEULAH BEUL	THES. DIA	DAY DAM	SMLS [] EXP	MT []		-		+	+	+
TOTAL THIS PAGE  TOTAL		DED   NO. TUBES			TONS	<u> </u>		+	+	+
POE-GREATPLAINS GASIF. PLANT PRODURACT LOCMM. BY 11/L. DOB NO. 5571	_					-	+	+		+
DOE-GREAT PLANS GASIF. PLANT PRODURACT LOC M.M. DATE YJANSE EST NO. 5571	TOTAL ACCOUNT					1	+		_	
FULAH, NORTH PAKOTA	CLIENT AMOCO	1	- 1	PROD FACT	100 1	3		•	3	2/2
	LOCATION B.	EULAH, NORTH	PAK 07A	MACC 0 A76	2 84 -	18	1		<u></u>	

	+									-		
	LUMMUS			ESTIMATE	SHEET						December 1	A WENT
					<b>00</b>	MTITY	CNIT	MATERIA		TO LABOR N		ACONTRAC
					MEO	TOTAL	COST	COST	-C			<b>202</b>
## 1 TOTAL ## 3 FET	STABILI		Ha									
				EU								-
TOTAL   TOTAL			_	SSD REAM		SOFT		_	0			_
				/SE HV		E.						
120   510	SHELL SIDE C.A.	-	TUBE SIDE C.A.	TIES -	-			_				
	50		\ \ \		-							_
WELLOED   SMIST   EXPLORATED   OCT	120 msic	C SA	0/1									_
	300 %	<b>36</b>	360	ے 0					_			
	CA MIN	}	] SMLS [] EXP	UMT []	 				-			_
NAPTHER STREET	WELDED []NO. TUR		Z.	ERECT. WT		TONSEA						
ENY   SOFTSHELL 3≤0 TOTAL SOFT 3≤0,55ENV   SOFT 3≥0    SHELL SIDE C.A.   mm   TUBE SID	EA GOS NAPHTHA	188	V	SEX	L .   <b>\</b>			_	=	L		-
ENV.   SOFTISHELL 350 TOTALSOFT 35\(\int \text{TRIV}\) \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		mm D/L		5	-							-
### DECT   100 PAIN	ERV.	1	TOTAL SOFT	14		50 FT	19	700	2			
SHELL SIDE C.A.   mm TUBE SIDE C.A.   mm   T		ł	TOTAL m2	l	-	E						_
O	SHELL SIDE C.A.	unu /	TUBE SIDE C.A.	-	-				_			_
	25		SS		-							-
220 of   20	100 mig		0	100 m.7								_
Ga win □ av □ weide □ shis □ sir ct wt         1000 sea           HDT MAPHTHA Cool ER         1000 sea           HDT MAPHTHA Cool ER         50 st 3           Fenv.   softshell 200 total soft 200 seav         50 st 3           Fenv.   softshell 200 total soft 200 seav         50 st 3           Fenv.   softshell 200 total soft 200 seav         mm           Fenv.   softshell 200 total soft 200 seav         mm           Fenv.   softshell 200 total soft 200 seav         mm           Fenv.   softshell 200 total	750 04	၁	0	ပ					=			_
##ELDED   MOD TUBES		f i	J SMLS [] EXP	INT C								
HPT MAPTIME COOLER  FIN. SOFT MAPTIME COOLER  FIN. SOFT MAPTIME COOLER  FIN. MASTH DAY MASTH DAY MAGE HATE  FIN. MASTH DAY MASTH DAY MAGE HATE  FIN. MAGE HATE  FIN. MASTH DAY MAGE HATE  FIN. MAGE HAT	S:WELDED   NO. TUB		(E)			TONSEA						
ENV.   SOFTSWELL 2023 TOTAL SOFT 2020 SERV    ENV.   Millswell 2023 TOTAL SOFT 2020 SERV    SPELL SIDE C.A.   mm   TUBE SIDE C.A.   mm    C.S.   Millswell 2023 TOTAL SOFT 2020 SERV   mm    C.S.   Millswell 2023 TOTAL M.S.    C.S.   Millswell 2023 TOTAL M.S.    C.S.   Millswell 2023 TOTAL M.S.    C.S.   Millswell 2023 SERV   mm	HPT	PHTHE	00						_			
ENV.   SOFTSHELL 2005 TOTAL SOFT 200 SERV   M2   C   C   C    SPELLSIDE C.A.   mm   TUDE SIDE C.A.   mm   TUD			A save	1								
SERV. m²/shēll 1014 m² Sierv mm 100 E side Ca. mm 100 E side E side Ca. mm 100 E side E s	40 SHELL/SERV. / SO		TOTAL SOFT			SOFT	B	-	Q			
## DECLAY NORTH PARCTA  ## BEULAH, PARCT		2/SHELL	TOTAL m2	SERV		Cm2						
1   O "SIG   120 or	SHELL SIDE C.A.	umu /	TUBE SIDE C.A.	/ ww								
			$\mathcal{L}S$									
A GA MIN CLARES   SMLS   EXP JOINT    S. WELDED CLIMO. TUBES   INSUL BY    INSUL BY CHANCE   INSUL BY CONTROL    INSUL BY CHANCE    INSUL BY CHAN		cm.)de	(30 msic)	1 cm. 200 A								
ILDED [] SMLS [] EXP JOINT []  JINSUL []  JINSUL []  SML SASIF. PLANT  PROD FACT  LOC. M.H.  DAK OTA  CONF. D. L. O. D. D.  EST NO. 5571  BATE 4J MAGE HATE  LAB. COST  REV. C.	30 525 arisad	၁၈	120 Or/	٥ċ							-	
POEL FROM COAL DEVIVED LY ONE FOR TOWS EAR TOWN SEA OF THE STATE OF TH		AV   WELDE	J SMLS   EXP	IINT []								
DOSE-GREAT PLAINS CASIF. PLANT PROD FACT LOC. M.H. BY 11/L. DOS NO. 5571  ULAH, NORTH DAKOTA USEL FKOM COAL DIVINED LYBURS  WAGE MATERIALE USEL FKOM COAL DIVINES WAGE MATE	IS WELDED []NO. TU		<u>, , , , , , , , , , , , , , , , , , , </u>		_	TONSEA						
DAE-GREATPLAINS GASIF. PLANT PRODERACT LOC.M.H. BY 11/L. DOB NO. 5571  SULAH, NORTH DAKOTA  WAGE RATE LOC.M.H. BAY 11/L. DOB NO. 5571  WAGE RATE LAB. COST REV. O	IS PAGE				-							
MOSE-GREATPLAINS GASIF. PLANT PRODERCT LOCIMH. BY 11/L. DONE 45 MO. 5571  ULAH, NORTH DAKOTA UEL FKOM COAL DELIVED LIQUIDS WAGERATE LAB. COST REV. C	COUNT											
LIBUIDS WAGE RATE LAB. COST REV. C	•	ATPUNINS G	16. 12	PROD FAC	_	LOC. N. H.	-	١		eQ.	8	•
LIBUIDS WAGE RATE LAB. COST REV. C	* BEULAH	NORTH DA	K07A		_		+	1	43	_		Ţ
	JET FUEL FROM	10 AC 775.14		WAGE RAT	-	LAB. 005T		<u> </u>	12	-		

ESTIMATE SHEET	SHEET					THE LUI	THE LUMMUS COMPANY	À
	OUANTITY	=	TINS	MATERIAL	Ļ	STD LABOR MH	C. Inc. Charge	
DESCRIPTION	REO EA		COST	C05T	5	·	1503	) L
1FA 601 CRUPE NAPHTHP FLED SURGE		-		-	-	L	-	
80 11	4000	188	3-	8	0			
3 m Umm U								
S					==	_		
DES PRESS 50 PSIG DES TEMP OF								
DES PRESS LOCATION OC				_	-		-	
NAAV.SPOT   100%   STRESS MEL   FAB.SHOP   FIELD		=		_				
BINTERNALS VORTEX BEEAKER							-	
10 INSUL (Z) HORIZ VERT (Z) SPHERE ERECT WT		TONS		-				
11 FA-602 DISTIL. COL'N REFLUX DRUM	,			   	  -			
12 3'-О'' 10    О'' тт тк ѕкіятнт	1000	SBT	3.	Sa Pa				
13 mm mm =				-		-		
14 MAT CS CLAD CUNING CA 1/4"   mm		-					-	
18 DES PRESS 75 PSIG DES TEMP 77/ OF				-	-			
NO DES PRESS					-			
17 X RAY SPOT   100%   STRESS REL   FAB SHOP   FIELD							-	
18 INTERNALS:		F		-	-	<del> </del>		
61		=		_			-	
20 INSUL   HORIZ (3) VERT   SPHERE		TONS		-				
RGE DRUM				-				
TT "0-18 OI "O.	1,000	SØT	3-	8	_		-	
23 m 🗆 mm		=			-	-		
MAT CS CLAD THING CA 1/4" / mm								
125				_				
DES PRESS								
27 X-RAY-SPOT [] 100% [] STRESS REL [] FAB-SHOP [] FIELD []					_		_	
28 INTERNALS:		-						
æ								
30 INSUL - HORIZ VERT SHPERE		TONS						
		=		_				
TOTAL ACCOUNT								
2		LOC. M.H.		À	1771.	ON BOT	1235	ACCT
		1000		DATE	E "JANS			₹
KINED LIGUIDS		7		REV				

A172 1081-8 REV. 2

SUBCONTRACI ACCT 7 THE LUMMUS COMPANY COST 1255 Disorrelield DATE (1 JANGE EST NO. E. HEV. C. STD LABOR MH TOTAL FINS 9000 MATERIAL COST 0/0 000 COST 4 3 19000 LBS LAB. COST Jaco LBS LBS TONS LOC. M.H. TONS TONS EA **QUANTITY ESTIMATE SHEET** REO 600 AREA WAGE RATE PROD. FACT PSIG DESTEMP 12.5 OF Ē SKIRT HT SKIRT HT MIN. SKIRT HT Ę ၁၀ ERECT. WT ၁ j o ပ ERECT. WT ERECT. WT. PSIG DES TEMP (70 OF PROJECT JET FUEL FROM COAL DERIVED LIYVIDS DES PRESS

Light | 100% | STRESS REL | FAB.SHOP | FIELD | DES PRESS LEMP DES TENDOS DES TEMP PELO DES TEMP apen DES TEMP PSIG DES TEMP 11/18 CLIENT AMOCO DOE-GREAT PLAINS GASIF. PLANT X.RAY.SPOT | 100% | STRESS REL | FAB.SHOP | FIELD | ¥ ¥ ¥ 74" CLAD []LINING [] CA /q" Damicster LOCATION BEULAH, NORTH DAKOTA HTHP SEPAKATOR CLAD | LINING | CA GLAD LINING CA INSUL | MORIZ | VERT | SPHERE |
FA. 606 LT/HP SCPAZATOR Ko DESCRIPTION F INSUL I HORIZ U VERT S SPHERE 1 "0.0 INSUL SHORIZ SO VERT SHERE MAX PROFIT 8:05 INTERNALS: Battle Deminter MAKEUP SUMMUS FEDOMENS 0 0 400 DES PRESS 37D TOTAL THIS PAGE TOTAL ACCOUNT Ģ CASE 7 INTERNALS: 3-6 INTERNALS: FA 605 DES PRESS | WW | E FA- 604 DES PRESS DES PRESS MAT MAT

MAX PROFIT

CASE 7

600AREA

A172 1081 8 REV. 2 SUBCONTRACT ACCT 4 THE LUMMUS COMPANY COST 1255 EST NO. STD LABOR MH TOTAL DATE //LANSE Ę ar.v 3000 1200 V MATERIAL COST ¥ 3-1 COST 3 7000 LBS LBS 4000 LBS LAB. COST TONS LOC. M.H. TONS TONS DUANTITY **ESTIMATE SHEET** REO WAGE RATE PROD FACT SKIRT HT SKIRT HT DES TEMP (70 of FRECT WT SKIRT HT Ę ပ Ē 40 ပ DES TEMP 170 OF ERECT. WT. FRECT. WT. ပ 2.0.7 PROJECT JET FUEL FROM COME DERINED INGENIES mil. hgycm2 DESTEMP Borms DES TEMP PSIG DES TEMP harma DES TEMP CLIENT ANJOCO /DOE-GREAT PLAINS GASIF. PLANT Boot 1 6" 10 4 REFLUX 77 X.RAY.SPOT | 180% | STRESS REL | FAB.SHOP | FIELD | X.RAY.SPOT | 140% | STRESS REL | FAB.SHOP | FIELD | 17 X.RAY.SPOT | 100% | STRESS REL | FAB SHOP | FIELD | ¥ ¥ SIS PSIG ----.4 LOCATION BEULAH, NURTH DAKETA CLAD | LINING | CA CLAD | LINING | CA RECYCLE GAS KO CLAD [] LINING [] CA DESCRIPTION 574816. F " "O-'II INSUL | HORIZ | VERT | SHPERE | 10 INSUL K) HORIZ | VERT K) SPHERE | 20 INSUL ( HORIZ A VERT SPHERE BINTERNALS DEMISTRY NAPYTHA Battle E E LUMMUS O. .O-, ō 370 100 TOTAL THIS PAGE TOTAL ACCOUNT 5.0" INTERNALS: IS DES PRESS INTERNALS: 11 FA 608 FA 607 DES PRESS 28 DES PRESS DES PRESS 16 DES PRESS 25 DES PRESE 13 mm | mm | 23 m | mm MAT Z KAT TAM AT

CA: 7	MAX PK	PROF1T			600 AF	<b>F</b>						
	SOM				ESTIMATE SHEET	SHEET					THE LUMMU	THE LUMMUS COMPANY
						OUA	OUANTITY	UNIT	MATERIAL	STOL	LABOR MH	SUBCONTRACT
	5	DESCRIPTION	2			REO	FA	COST	COST	+INS	TOTAL	COST
1GA. 601A/S	CRUDE 1	NAPHTHA	74 FEED	4		2			Goo			
2 GPM 25		PSIG			TEMP 33 OF							
3 m³/h	SUCT	boscm?	horem2 DISCH	T Sunda	TEMP OC							
₽ CR.	٥٥	Ħ	5	PSI	STGS							
*	Δr	E		, o	MAH							
6 MAT CASE C	\ \	IMPELLER	LEA CS		1.540							
7 DRIVE EM - KD TU	TURB   DIESEL	OTHER	ER []		X.Y							
6			ERS API	ANSI		-			_			
	,											
10 INSUL X			ERECT WT		PUMP & DRIVER		TONS					
11 GA 6 02 A/5	DISTIL.	1700	BOTTOMS	8		2			8000			
8	SUCT	PSIG	DISCH	īS	TEMP 27505							
13 m <sup>3</sup> /h	SUCT	Porcm?	borem 2 DISCH	1 Cm 2 1	TEMP OC							
14 SP GR	ΔP	FT	0	PSI	STGS							
15	40	E		korm2	APR				_			
16 MAT CASE	CS	IMPELLER	LER CS		дн /							
17 DRIVE EM - KU TU	TURB   DIESEL	🗌 отнея	FR 🗌		rw.							
18 TYPE CENT - IN RE	RECIP   PROP	OTHERS	RS 🗌 API	ANSI	)							
19 MECH. SEAL K												
20 INSULE			ERECT WT PUMP &	WT PUR	IP & DRIVER		TONS					
21 GA 603A/S	PISTIC.	1700	REFLUX			2			8000			
22 GPM 45	suct	PSIG	PSIG DISCH		TEMP 100 OF							
23 m <sup>3</sup> h	SUCT	Novem2	Norma DISCH	Morem T	TEMP OC							
24 SP.GR	Δ۴	FT	30	PSI	STGS							
33	٥	£		10/cm2	APM	-						
26 MAT CASE C	. 5	IMPELLER	LER CS		2 HP.							
27 DRIVE EM - KJ TU	TURB   DIESEL	🔲 отнея	ER []		W.							
28 TYPE CENT - ED MI	RECIP   PROP	□ OTHERS	RS API	ANSI	7						[ 	
29 MECH. SEAL X												
30 INSUL 🔯			ERECT	WT PUR	ERECT. WT PUMP & DRIVER		TONS					
TOTAL THIS PAGE									-			
TOTAL ACCOUNT												
CLIENT AMOCO/DOE-GREAT PLAMS GASIF.	100E-5R	SAT PU	AWS 9451	IF. PUM	PROD. FACT	1:	LOC. M.H.		<b>A</b>	73	ON BOY	557, ACCT
LOCATION BEULAH	16AH 1 NO	NORTH	CAKOTA			+		-	DATE	4 Jan 86		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
PROJECT JET FUEL FROM COAL UCZIVED LAWING	UEL FROM	1007	DESIVED	10001	WAGE RATE	<u>.</u>	LAB. COST		HEV.	0		-

ווי			w	ESTIMATE SHEET	SHEET					Bloomfield	Bloomfield
	Į				OS A	DUANTITY	LINS	MATERIAL	STDL	STD LABOR MH	SUBCONTRACT
	-	DESCRIPTION		<u>.                                     </u>	REO	EA	COST	COST	t in	TOTAL	COST
GA: 404A/S	HDT F	FEED			2			2000		+	
2		PSIG DISCH	PSI TEMP	275					1	-	1
1	SUCT	Lorenz DISCH	NOT TEMP	Do de							
Se CH	D.	218	ISd	STGS					+	+	†
	ΔP	E	Lps 2	1	-			+	+	1	
MAT CASE		IMPELLER		30 HP	-			1	+	+	
Ø	TURB   DIESEL	L OTHER		k %				+		-	
		] OTHERS []	API [] ANSI					+		+	
\					+				+	+	
10 INEUL R		E	ERECT WT PUM	PUMP & DRIVER	1	LONS			+		
11 GA 605 A/S	PROCESS	SS WATER			2			000	+		
12 GPN	SUCT	PSIG DISCH	PSI TEI	2						-	
1	SUCT	MDSCM DISCH	harmy TEMP	Oc div				_	1	+	
14 SP.GR	۵¢	סוך ויי	PSI	STGS						+	
	ð	E	agrem 2	APM						+	
MAT CASE	75	MAPELLER	57	O HP						1	
123	TURB DIESEL	LO OTHER		N.W.					1	+	
ا ــــــا		OTHERS []	API - ANSI					1	1	+	
MECH SEAL []									1		-
20 INSULED			ERECT WT PUMP	PUMP & DRIVER	,	SNO			1	+	
21 GA 606A/S	N IdH	NAPHTHA			2			8	1		
22 GPM 2.0		PSIG DISCH	PSI	TEMP 2750F				+		+	
	SUCT	HOSIO CHESCH	horma TEMP				$\left\{ \right.$		1	+	
2 SP CR	0	11 30	PSI	STGS				1		+	
	00	E	agicm <sup>2</sup>	APA						1	
MAT CASE	5	HAPELLER	. 5	4'H				1	1		
R		DIESEL OTHER		A N				-	1		
TYPE CENT - 10	1-	OTHERS	API ANSI					1		-	
1								-		1	
30 INSUL [3]		EP	ERECT WT PUM	PUMP & DRIVER		TONS		-	1	+	
TOTAL THIS PAGE								+	1		
TOTAL ACCOUNT						=		+		-	
CLIENT AII/OCO	0/106-6	2	HSIF PLANT	PROD FACT		LOC. M.H.		Y8 0	117	EST NO.	1255
LOCATION BEULAL	447	v	AKOTA		<del> </del>	1903	-		NH C	9	- <b>-</b>
		•				こうろう アレコー	_	A 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	`		

CA. 7 K	MAX PROFIT	FIT		600 A/	- I							
SUMMUS FEDOMENS	MUS			ESTIMATE SHEET	SHEET					THE LUMN	THE LUMMUS COMPANY	È
		100			Ş	DUANTITY	UNIT	MATERIAL	F	STD LABOR MH	SUBCONTRACT	TRACT
		DESCRIPTION			REG	Æ	COST	COST	TINS	TOTAL	C051	
1 GA 607A/S	NASHTHA	STABIL.	REFLUX		2			800				
2 GPW 30	SUCT	PSIG DISCH	PSI TE	TEMP /OO OF								
3 m3.h	SUCT	Porcm DISCH	Agrems TE	TEMP OC								
4 SP.GR	ΔP	FT 30		STGS								
8	<b>₽</b> ∇	E	hpe.	RPM								
6 MAT CASE	52	IMPELLER CS		AHS'								
7 DRIVE EM - IN TO	TURB   DIESEL	_		r.v								
B TYPE CENT - [3] R		Ö	API 🗍 ANSI 🗌	)								
10 INSUL [Z]		13 1	ERECT. WT PUMP & DRIVER	P & DRIVER		TONS		-				
11 GA 608 A/S	Souk WA	WATTER			7			8000	0			
2/1 MdD 21	SUCT	PSIG DISCH	PSI TE	TEMP OF								
13 m <sup>3</sup> /m	SUCT	hpicm2 DISCH	Agicm2 TEMP	NP OC				_				
14 SP.GR	۷۷	FT	150 00)	STGS								
15	Vδ	E	hpa ,	MAH								
16 MAT. CASE	CS	IMPELLER /	261	12 HP								
17 DRIVE EM - KA TU	TURB   DIESEL	] отнея []		kW.								
10 TYPE CENT -   R	RECIP   PROP	OTHERS [	API 🗌 ANSI 🗍									
19 MECH. SEAL []												
20 INSUL		ERI	ERECT WT PUMS	PUMP & DRIVER		TONS						
21 GA												
22 GPM	suci	PSIG DISCH	PSI TE	TEMP OF								
23 m <sup>3</sup> m	suct	Larcm2 DISCH	hgicms TEMP	MP OC								
24 SP GR	۵۴	FT	73	STGS								
22	٥٠	E	40cm2	MAH					-			
28 MAT CASE		IMPELLER		I								
27 DRIVE EM - 🔲 TL	TUMB   DIESEL	🗌 отнея 🔲		W								
28 TYPE CENT -[] R	RECIP   PROP	OTHERS API	II ANSI	-								
29 MECH. SEAL		1										
30 INSUL []		ERI	ERECT WT. PUM	PUMP & DRIVER		TONS						
TOTAL THIS PAGE												
TOTAL ACCOUNT												
CLIENT AMOCO/DOE-6/2647	100E-616	25	INS GASIF. PLAIM	PROD FACT	<del>t.</del>	LOC. M.H.	<u></u>	à	7/11	JOB NO.	1255	ACCT
PROJECT TET EUF EPONT CAN	WENT NOX		MKOJA DETIVED I KOUDE	WAGE RATE	 	LAB. COST	_	DATE REV	re //340.88			<b>∀</b>
/ / 1	77.~ 17.0		7 7 7	<b></b>	$\frac{1}{4}$		-	1			1	

		ESTIMATE SHEET	SHEET					THE LUI	THE LUMMUS COMPANY	ÀN.
			OCA.	QUANTITY	UNIT	MATERIAL		STD LABOR MH		TRACT
DESC	DESCRIPTION	<u> </u>	REO	FA	COST	COST	3	IT TOTAL	Γ	1.
1 GB GOLA/B MAKEUP	GAS COMPRESSOR	2	2				_			
2 CAP. SCFM (4 STM	<u> </u>	(D) 1 142	-			1100	80			
3 MAT'L HANDLED 99,99 % H2	01%C1	2,02 mm	-							
4 SUCT 340 PSIA/	horms TEMP OF	၁၀								
6 DISCH 340 PSIA!	100 cm 1, 43	srgs /	-			-				
		VOLTS	-							
7 DRIVER-EM SETURB DDIESEL	20 BHP/	A.	-							
BINCL: GEAR XLUBE & SEAL XINTERCOOLER	COOLER[]COND[]									
9 TYPE CENT [] RECIP K ROTARY []	] screw []									
10 INSUL [2]	ERECT WT COMPR + DRIVE	APR + DRIVE	-	TONS						
" G+ 602A/R RECYCLE	5AS COMPRESSOR	550R	2			1200	000			
12 CAP SCFM 1050 STM	/SIS4	6111016								
13 MAT'L HANDLED 95 % H2	19/12 4% C.CL	4.1 mm								
14 SUCT 705 PSIA!	hyperical TEMP /200 OF	J <sub>o</sub>								
15 DISCH 840 PSIA!	co100 /.39	STGS /	_							
16 MAT. CASE CS IM	IMPELLER	VOLTS								
17 DRIVER EM 🔯 TURB 🗌 DIESEL 🗍	20 BHP/	KW					-			
18 INCL. GEAR IX LUBE & SEAL IX INTERCOOLER [] COND	ERCOOLER COND						-			
19 TYPE CENT   RECIPIN ROTARY	SCREW []									
ZO INGUL [K]	ERECT WT COMPR	PR + DRIVE		TONS						
21 GB.										
ZZ CAP. SCFM STM	PSIG PS/PP PS/PP	19/2								
23 MAT'L HANDLED		MAN								
24 SUCT PSIA/	hpcm2 TEMP OF	ာ့								
25 DISCH PSIA/	<i>₹</i> 0/ <i>€</i> 5	STGS								
		VOLTS KW								
27 DRIVER EM TURB OFESEL	DHP/	WH								
28 MCL: GEAR   LUBE & SEAL   INTERCOOLER   COND	RCOOLER COND									
29 TYPE CENT   RECIP   ROTARY   SCREW	] SCREW []						==			
30 INSUL [	ERECT. WT. COMPR	PR + DRIVE	-	TONS						
TOTAL THIS PAGE						- 	-			
TOTAL ACCOUNT										
CLIENT AMICO DUE - GREAT PLAWS	PRAINS GASTE PLANT	FROD FACT	1	LOC MH			BY 1/4.	ON BOY	1633	ACCT
LOCATION BEULAH, NOS	SETH DALCTA		-		1	٦	DATE 45	4 JAN 88 EST	11 66	89
PROJECT JET 1'1 64 11'M &	CAL DERINCOUS	WAGE RATE	E	LAB COST		<u>.</u>	BEV U	•		

A177 1081 11 REV 2

CLIENT: DOE

PROJECT: 5571

OCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

22-Mar-89 09:08 AM

EQUIPMENT

# PCS. \$ EQUIP. \$ COMM \$ COMM

**HEATERS** TOWERS INTERNALS REACTORS **EXCHANGERS** AIR COOLERS **VESSELS** TANKS **FILTERS PUMPS** 

PACKAGE UNITS

TOTAL

COMPRESSORS

			· · · · · · · · · · · · · · · · · · ·
10	\$350	140	\$490
	\$66		
20	\$113	100	\$113
9	\$65	1204	\$78
7	\$117	100	\$117
44	\$180	120	\$216
		60₹	
3	\$20	100	\$20
93	\$911		\$1,034

# SUMMARY

**EQUIPMENT** 

\$911

COMMODITIES

\$1,034

LABOR

\$712 (10% EQUIP,60% COMM)

INDIRECTS

\$712 (100% LABOR)

**ENGINEERING** 

\$4,464 (800/PC X \$60)

SUBTOTAL

\$7,832

CONTINGENCY

\$1,566 (20%)

TOTAL

\$9,398

**ESCALATION** 

\$940

10.0%

TOTAL

\$10,338

1

ACCT MADE FOR FORM SUBCONTRACT THE LUMMUS COMPANY COST 5571 Bloom/leld JOB NO. STD LABOR MH TOTAL DATE 12//8/87 CNIT REV. 38000 45000 24600 ¥ MATERIAL COST 25 000 LBS 1250 55C UNIT 7 LAB COST 188 LOC. M.H. 18,000 LBS TONS TONS TONS 6000 ¥, DUANTITY **ESTIMATE SHEET** REG MOSECT JET FUGL FROM COAD DERIVED LAUIDS WAGE HATE PROD FACT 400 % E PSIG DESTEMP 250 OF 19'-0" SHIRT HT ٥ Ē 30 OS 5'-0" SKIRT HT ပူ 5'0' SKIRT HT ပ IN ERECT. WT IN ERECT WT. IDS ERECT WT. CA 1/8" CA 1/8" RAFFINATE WATER WASH COLUMN ., 8/1 VO PSIG DES TEMP PSIG DES TEMP Barems DES TEMP CLIENT AMOLO/DO 6-SREAT PLAINS GASIF. PLANT MOTOR DES TEMP Bycms DES TEMP X-RAY-SPOT | 100% | STRESS REL | FAB-SHOP METELD K.RAY.SPOT | 100% | STRESS REL | FAB.SHOP | FIELD X.RAV. SPOT [] 100% [] STRESS REL [] FAB. SHOP [ ] FIELD ¥ ¥ ¥ EXTRACTOR COLUMN CLAD [] LINING CLAD [] LINING [] INTERNALS' TRAYS-INSTALLED SHOP [ FIELD [ IB INTERNALS TRAYS-INSTALLED SHOP TELD CLAB | LINING | INTERNALS, TRAYS-INSTALLED SHOP TELD \$3.0,11 11,0,09 11,0-,607 DESCRIPTION MAX PROFIT 150 8-Tum - 90 va 135 Bittom. STRIPPER 9 · · · · 2,-6" 10 .6-,2 - 40 . V S TOTAL THIS PAGE 2 • ₩0 TOTAL ACCOUNT V V C. 13 E. 21 DA 703 23 m | mm | CZ 25 DES PRESS 26 DES PRESS SO INSUL S DES PRESS DA: 702 LI LIVE DES PRESS DES PRESS DES PRESS DA 701 INSUL [] 10 INSUL X MAT ¥ M

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CASE 7 MAX PROFIT

CLAD LINING CA 1/8'-C	ECTIMATE CUEET	UEET				THE LUMMUS COMPANY	S COMPANY
04.704						Bioon	flefd
10	NOTALISA	DUANTITY	LINO	MATERIAL	2	LABOR MH	SUBCONTRAC
04.7 0.4			203	cost	3	TOTAL	COST
### 1	KECOVERY COL		-				
MAT — C S. CLAD □UNING □ CA '/g''   mm   mm   mm   mm   mm   mm   mm	3'-0" ID //2'-0"TT TK /8'-0"	9 000 LB	250				
Section   Sec	m   mm						
NET	CS. CLAD LINING CA 1/8"						
NEST ENTER STATE   PROPERTY   PR	50 PSIG DES TEMP 400						
NATERIALS TRAYS—NET ALLEO SHOP Greet D Greet	horn DES TEMP						
MESTING DATE TRAYS—INSTALLED SHOPE OF LIFE LED []  DATOS WATER STREET OF TREET WIT TO A 1/8"   1				_			
No. 1   No. 2   No. 1   No. 2   No. 1   No. 2   No.							
03-705 WATER 57R IP PER 1 100 S							
00.705 WATER STRIPPER    1	DA. the DB.	SNOT					
	WATER STRIPP		-				_
MAT. CS CLAD[LINING] CA \( \frac{\gamma_1}{\gamma_1} \)  OES PRESS  SO PSIG DES TEMP 3/0° T  OES PRESS  VIRTUAL STREET OF CLAD[LINING] CA \( \frac{\gamma_1}{\gamma_1} \)  NINTERNALS TRAYS-INSTRICT BRIEF OF CLAD[LINING] CA \( \frac{\gamma_1}{\gamma_1} \)  NINTERNALS TRAYS-INSTRICT BRIEF OF CLAD[LINING] CA \( \frac{\gamma_1}{\gamma_1} \)  NINTERNALS TRAYS-INSTRICT BRIEF OF CLAD[LINING] CA \( \frac{\gamma_1}{\gamma_1} \)  NINTERNALS TRAYS-INSTRICT BRIEF OF CLAD[LINING] CA \( \frac{\gamma_1}{\gamma_1} \)  NINTERNALS TRAYS-INSTRICT BRIEF OF CLAD[LINING] CA \( \frac{\gamma_1}{\gamma_1} \)  NINTERNALS SOT [1000] CSTREES  OES PRESS  NINTERNALS TRAYS-INSTRICT BRIEF OF CLAD[LINING] CA \( \frac{\gamma_1}{\gamma_1} \)  NINTERNALS SOT [1000] CSTREES REL]  NINTERNALS SOT [1000] CSTREES  NINTERNALS TRAYS-INSTRICT BRIEF OF CAPART  NINTERNALS TRAYS-INSTRICT BRIEF OF CAPART  NINTERNALS AND SOT [1000] CSTREES  TOTAL THIS FAGE  TO	- xt TT"0-'05 10 3-'/	000					
DES PRESS  OR ST CLAD □LINING □ CA \Bar{B}'' \ mm  OR ST PRESS  OR ST							
DES PRESS  SET INTERIOR   STREET   STR	CS CLAD [LINING [] CA 1/8"						
NET CASE OF STATES REL DES SHOP METER OF STEAM O	DES PRESS 50 PSIG DES TEMP 3/0						
NHERNALS TRAYS-INSTALLED SHOP BLELO    NHERNALS TRAYS-IN	Marina DES TEMP						
FLANSEC BOTH CHELD	X RAY-SPOT   100%   STRESS REL   FAB-SHOP						
FLANGEO BOTH ENDS, TOP MH. COVER.   In FRECT WT   TONS   TONS							
1	FLANGED BOTH ENDS, TOP MH						
1	INSUL SE DA- No DO- IN FRECT	TONS					
- 9'   10   5'-0" TT   TK 6'-0" SHIRTHT   3000 LBS   - 2000 LBS   -	DA 706 SOLVENT REGENER						
MAT. C.S. CLAD LINING SETEMP 4.00 °F  DES PRESS  DES P	1'-9" 10 /5'-0" TT TK 6'-0" SHIRT	000	<b>\</b> 1	2000			
C.S. CLAD LINING  CA 1/8"   mm   ca 1/8"   ca							
DES PRESS  DES PRICE  DES PRESS	C.S. CLAD TINING CA 18"/						
NY SECULIARY NORTH DAKOTA  NY SECULIARY NORTH DAKOTA  NY SECULIARY SHOPE BY I FILE OF SHO	DES PRESS 50 PSIG DES TEMP 400						
INTERNALS TRAYS-INSTALLED SHOP [SFIELD []  E.A710 THR. STREET INCET DITTE [], 6" MPOL MESH.  INSUL MEDIAL STREET INCET DITTE [], 6" MPOL MESH.  TOTAL THIS PAGE  TOTAL THIS PA	DES PRESS						
INTERNALS THAN SHELL, INLET DITTE 18, 6" MAPAL MESH.  INSUL 2 DA - the DB -	X RAY SPOT [] 100% [] STRESS REL [] FAB SHOP						
EA-710 THRU SHELL, INLET DITTRIB, 6" MPOR METH.  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOS OF SHEAT PLAINS SASIF. PLANT  CLIENT AMOS OF SHEAT PLANT  CL	B INTERNALS' TRAYS-INSTALLED SHOP [ FIELD [						
TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOLO/NO S-SREAT PLAINS GASIF. PLANT  TOTAL THIS PAGE  TOTAL THIS PAGE	EA-710 THRU SHELL, INVET DITTELS, 6" MPOR						
PLANT PROD FACT LOC.MH. BY #/L JOB NO. 5571  LOUIDS WAGERATE LAB. COST REV. △	INSUL SO DA- the DB- ths	TONS					
PLANT PROD FACT LOC. M.H. BY #/L JOB NO. 5571  LOUIDS WAGERATE LAB. COST REV. △	TOTAL THIS PAGE						
PLAM PROD FACT LOC.MH. BY #L JOB NO. 5571  LOUIDS WAGERATE LAB. COST REV. O.	TOTAL ACCOUNT						
LøwDS WAGERATE LAB. COST REV. ♦	PLANT	LOC. M.H.		λ8	ML	\$0. 5	123
LAGUDS WAGERATE LAB COST REV.		+		DATE	<u>%</u>	123	
	LI QUIDS	LAB COST		HEV.	0		

CASE 1 MAX PILOFIT	EA							
ESTIMATE SHEET	SHEET						THE LUMBL	THE LUMBUS COMPANY Bloomfold
	3	QUANTITY	LINS	MATERIAL	<u>ا</u> پر	8401	LABOR MH	SUBCONTRACT
DESCRIPTION	REG	EA	COST	COST		TINS	TOTAL	COST
DA 7074/A CLAY TOWERS	2					1	1	-
01.7		// 000 LBS	3-	dep	8	1		1
l l l l l l l l l l l l l l l l l l l		640.4			7	1	+	
MAT. CS CLAD LINING CA 1/8"		`			†	+	1	
DES PRESS 365 PSIG DES TEMP 450				+	†	1	+	
					+	+		
					†	1		1
B INTERNALS TRAYS-INSTALLED SHOP TELD []	1			1	+	$\dagger$		
					†	1		-
10 INSUL 20 DA- To DB- IN FRECT WT		TONS			†	1	+	-
00				1	1	1	+	-
3.6" 10 130'-0"	_	25,000 LBS	9	30	0	+	+	-
					†	1		+
C.S. CLAD LINING CA 1/8"					1	1	+	-
MESS SO PSIG DESTEMP 360					7	1	+	+
16 DES PRESS LOCAL LOCAL DES TEMP OC				1	†	1	+	
17 K. HAY SPOT   100%   STRESS REL   FABSHOF BEIELD				1	1	1		+
18 INTERNALS TRAYS-INSTALLED SHOP SFIELD				1	†	1		-
6.				1	†	1		1
20 INSUL M DA - 10s DB - 10s ERECT WT		TONS		1	7	1	1	+
TOLUENE COLUMN	-		,	7	+	1	1	+
.0-,111 a .,0-,2		5,000 185	3-	130	8		1	
23 m 🗆 mm 🗆				1	1	1		1
<u></u>					†	1	-	
DES TEMP 390				1	1	1	1	-
DES PRESS				1	†	1		
27 X RAY SPOT [ 100% STRESS REL [ FABSHOP SFIELD []					†	1		-
28 INTERNALS' TRAYS-INSTALLED SHOP [] FIELD []					†			+
*				1	1	1		
30 INSUL DS DA - By DB - By ERECT. WT		TONS		1	↟	1	+	 
TOTAL THIS PAGE				1	†	1	+	<del> </del>
TOTAL ACCOUNT	]		}	1	7			1550
REAT PLAIN		10C. # H.			97.45	12/10/5	EST NO.	1255
LOCATION BEULAH NORTH DAKOTA	   <u> </u>	LAB. COST	-		•	)   		•
תניאות בת התחום	1	1	1			,		W761 1 1001 CC 1

	THE LUMMAUS COMPANY Bloomfield		ST UNIT TOTAL COST			· cac									000																			7 5	14.4	11313 1 1311 1 1111
		-	COST CO	-		150	+		-	+	+		+		十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十十	1		+	-	-		-		1	2	+	_					-				
		F					+			+	3,000		+	+	1	+		+	+	+	TONS		+		+		-				TONS			LOC. M.H.	LAB. COST	
	SHEET	QUANTITY	REO			100	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	-		+	+	+		_	3	\ \ 		+		+	+	+	+		30	+	+							FACT	RATE	
	ESTIMATE SHEET				NO PASSES	,	3				822	EMEC! W	2	NO PASSES		-	_		-		CBECT WT	Eur.		NO PASSES	2	1	1	1	-	1/8	ERECT. WT			PROD FACT	WAGE BATE	7
					MAT		ŝ	1			VAKTEX BKK		Z	MAT	۲۷	< >			\ -\	-	FEED		-	MAT	°	+	1	+	+	T DISTAIR	}			PLANT		710017
			NO	TRAYS	DIA m   mm			ļ			5 IN 87M.		TER WITH	01A m [] mm[							WC IN 8TM.									Paul Inte	1			NS 650 SIP.	DAKOTA	AL DERIVED
i V			DESCRIPTION	1	<	2'-6"	5:-6:				GRATINS		WA	A IC	9-,1	1,5-1,					SMITHS	- }	.1		,6-,2		\ -		1	100	1			MPA	NORTH	Rum Co
1	CASE 7 MAX PROFILE	I SIUMMUS		OB 701 EXTRACTOR	1406	STRUMG TRAY	RAIN DECK				OTHER INTERNALS 6" OF	0,	11 DE 702 PAFFINATE	TVI	13 ( 14 - 1 1 W. CONTRETING	Y		92	11		19 OTHER INTERNALS & "OF	92	21 04 703 STRIPPER	ZZ TYPE	B VALVE	7	R	26	$\mu$	<b>*</b>	WOTHER INTERNALS: KE 6:// // /	_	TOTAL THIS PAGE	CLIENT AND CO DOB - GREAT PLAINS	LOCATION BEULAH, NORTH DAKOTH	MOJECT FUEL FI

MAX PROFIT

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CASE

SUBCONTRACT ACCT 80 THE LUMMUS COMPANY COST 1255 Bloomfield ġ STD LABOR MH TOTAL EST DATE /2//8/87 TINES 1/1 8 8 80 REV MATERIAL COST ¥ 150 COST 150 75 LAB. COST TONS LOC. M.H. TONS TONS EA **OUANTITY ESTIMATE SHEET** REG رړ N B 700 AREA WAGE RATE PROD FACT NO PASSES NO PASSES NO PASSES ERECT WT ERECT WT ERECT WT N LOCATION BEULAH. NORTH DAKOTH
MONECLET FUEL FROM COALDERIVED LIQUIDS MAT cs TRAYS S S TRAYS MAT MAT 5 ũ Š CLIENT AND CO DOB - CREAT PLAINS SASIF. PLANT DIA m | mm | DIA m | mm | Oth m | mm | N11/0707 STRIPPER DESCRIPTION OTHER INTERNALS VORTEX PKK. 3'-0" 3'-0" 3'-0" 3'-0' ۷iQ VALVE ( " OKTE 1546) 1'-6" DIA 8 IN SHELL. RECUVERS WATER LIQUID DISTRIB. COLLECTORI EA-705 OTHER INTERNALS: OTHER INTERNALS TOTAL THIS PAGE TYPE TYPE TOTAL ACCOUNT VALVE PROJECT (FT VALVE TRAPS 20 704 705

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CASE 7 MAX PROFIT

ESTIMATE SHEET  OBJOINTITY  OB				•									<b>&gt;</b> X<		
Cost					STIMATE	SHEE	_					Bloomfield			
TOTATE CLAY TOWARD   TOTAL						8	ANTITY	UNIT	MATERIAL	9TC	LABOR MH	SUBC	DNTRA		
				,		REO	EA	COST	COST	UNIT	TOTAL	0	OST		
Tree   Dia   Dia	707118	Town	XX	4									_		
Control of the cont		<b>VIQ</b>	DIA m   mm	MAT.	WO. PASSES										
C. CAY   - PLT Del 4(2)															
### CONTRIBUTE A - 6' SCCTOUT OF CUTTLE MEETY   TONS      10	CLAY - FILTEN GR.	4	240 FT3												
ER INTERNALE 4 - 6" SCCTOUT OF CUIET MELLY  TO STANCE GREEN TO TAKE THE TOTAL STREET WIT  TYPE  THE TAKE THE TA			20 10 5	7	PREE								H		
ER INTERNALS. 4 - 6' SCC770/1 OF COLAR MENT TO PASSES  70 8 BCM-BCAC COLUMY TALAY!  70 8 BCM-BCAC COLUMY TALAY!  71 8 CALUM TALAY!  72 10 CALUM TALAY!  73 CALUE COLUMY TALAY!  74 VE  75 TOLU CALUM TALAY  75 TOLU CALUM TALAY  76 TOLU CALUM TALAY  77 TOLU CALUM TALAY  78 TOLU CALUM TALAY  78 TOLU CALUM TALAY  78 TOLU CALUMATALS.  79 TOLU CALUMATALS.  70 TOLU CALUMATALS.  70 TOLU CALUMATALS.  70 TOLU CALUMATALS.  71 TOLU CALUMATALS.  72 TOLU CALUMATALS.  74 TOLU CALUMATALS.  75 TOLU CALUMATALS.  76 TOLU CALUMATALS.  77 TOLU CALUMATALS.  78 TOLU CALUMATALS.  78 TOLU CALUMATALS.  79 TOLU CALUMATALS.  70 TOLU CALUMAT															
ER INTERNALS 4 - 6' SECTIONS OF OUR MESTY.  TOP FOR THE PROPERTY TO PASSES  TOP TOLUE SECTIONS AND THE PROPERTY TOWS  TOWN TOWN TOWN TOWS  TOWN TOWN TOWN TOWN TOWS  TOWN TOWN TOWN TOWN TOWN TOWS  TOWN TOWN TOWN TOWN TOWN TOWN TOWN TOWN													$\downarrow$		
### INTERNALS  #### INTERNALS  ##### INTERNALS  ##### INTERNALS  ##### INTERNALS  ###################################		_		[						+		+	+		
10	12.4	`!	9	9									$\downarrow$		
70 \$ BENZENC COLUMN TRAYS  TYPE  13-6  13	ERHMIC BATCS	હ	ᆡ		RECT WT		TONS			1		-	$\frac{1}{1}$		
TALVE         OTHER INTERNALS.         C S I G G G G G G G G G G G G G G G G G G	306		Į.	7									_		
VALVE         3:-6'         CS         I 6'         Abot         Abot           OTHER INTERNALIS         ERECT WT         TONS         TONS         ERECT WT	TVPE	₽M	₽Ð	_	NO PASSES							=			
CHER INTERNALS:         ERECT WT.         TONS           CHECT WT.         TONS           CHECT WT.         TONS           CHECT WT.         TONS           CHECT WT.         TONS           TOTAL THIS PAINT SASIF, PLAUT         FRECT WT.         TONS           TOTAL THIS PAINT SASIF, PLAUT         FRODE FACT         TOC M.H.         BAY ALL ALL PLAUT           FROGET WT.         TONS         FAMEL         BAY ALL ALL PLAUT         BAY AL	ralve	3,-6			1	jo		3700	1200						
00-7 of the internals  CHECT WT  TOWS  TOWS  TOWN  TO										4			_		
OTHER INTERNALS.  DB-709													4		
OFHER INTERNALS:         ERECT WT         TOWS           DB-709 ToLUE/ME COLUMN TRAYS         ERECT WT         TOMS           VALVE         2'-0"         And DIA III MAT. NO. PASSES         And DIA III MAT. NO. PASSES           TRAYE         2'-0"         C.S.         1         So.         Co.         TOWS           TOTAL THIS PAGE           TOTAL THIS PAGE <th <="" colspan="2" td=""><td>•</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td><td><math>\dashv</math></td></th>	<td>•</td> <td></td> <td>-</td> <td><math>\dashv</math></td>		•											-	$\dashv$
CUENE COLUMN TRAYS													$\dashv$		
LUENE COLUMN TRAYS       TRAYS         Q1A OLIA MAT MAT NO PASSES       CS 1 50 700 700         2-0       CS 1 50 700         2-0       CS 1 700													4		
TOLUENE COLUMN TRAYS  TOLUENE COLUMN TRAYS  TYPE  DA DIAM DIAM MAT. NO PASSES  P  2 -0	OTHER INTERNALS:														
TOLUENE COLUMN TRAYS  TVFE DIA DIAMINM MAT. NO PASSES  VG COLUMN TRAYS  VG COLUMN TENALS  ERECT WT  TERNALS  ERECT WT  TENALS  ERECT WT  TENALS  ERECT WT  TONS  HISTORIA DIAMINS GASIF. PLANT  WAGE RATE  TONS  HISTORIA DIAMINS CAST TRANS  WAGE RATE  TON HISTORIA  HISTORIA DIAMINS CAST TRANS  WAGE RATE  TON HISTORIA  HISTORIA DIAMINS CAST TRANS  WAGE RATE  TON HISTORIA  BOTTORIA  BOTTORI				E	RECT WT.		TONS			_					
TQAP         2 '-0'         C S         1         50         200         500           TQAP         2 '-0'         C S         1         50         200         200           TQAP         2 '-0'         C S         1         50         200         200           TOTAL THIS PAGE         ERECT WT         TONS         ERECT WT         TONS         2         200         200           TOTAL ACCOUNT         CLIENTAMOS SASIP. PLANT         PROD FACT         LOC. M.H.         BY ML         300         55.71           LOCATION BELL CROW CALL DELIGITOR         WAGE RATE         LAB. CALL DELIGITOR         BRV ALL         BN ML         BN ML	De 709		1 TR	۲۶.											
TANP   2'-0'   CS	TVPE	Vŏ	DIA m		NO. PASSES										
2'-O' C.S	VALVE	0-,2		52	1			100		,					
MEL ERON COAL DEPUND & WAGE RATE LOS IN BY ML DOBATE 12/MY?  TONS  FOR MALE NOB FOR 100 FOR 10	TRAP	2,0,				1									
OB-CECT PLANT SASIF. PLANT FROD FACT LOC M.H. BY ML 108 NO. 5571												_			
MEL ERON COAL DEPUND & WAGE NATE LOS MH BY ML LOS NO. 5571												+	4		
OB-GREAT PLAINS SASIF. PLANT PROD FACT LOC. M.H. BY ML 108 NO. 5571										1			$\frac{1}{1}$		
OB - GREAT PLAINS SASIF. PLANT PROD FACT LOC. M.H. BY ML 108 NO. 5571												+	$\downarrow$		
451/F. PLANT PROD FACT LOC.M.H. BY ML 108 NO. 5571  201/ED 1101112 & WAGE RATE LAB COST REV													+		
HSIF. PLANT PROD FACT LOC.M.H. BY M.L. JOB NO. 5571					RECT WT		TONS				$\frac{1}{1}$	4	4		
1	TOTAL THIS PAGE											+	$\dashv$		
COTH PROD FACT LOC M.H. BY M.L. JOB NO. 5571	TOTAL ACCOUNT							┇		1			1		
FUEL CRUM CAAL DEPLYED LADING WAGE RATE LAB. COST	CLIENT ANS CO DOG - GRE		25.6	AUT	PROD FA		LOC. M.H.		84	ML	\$ 55 C	55	٧٥		
	T FUEL	00 00	AL DEPIVED LI	Saring	WAGE RA	22	LAB. COS	_	3	10/0/2					

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	THE STOWNUS				1						اة	omiliate
		DESCRIPTION	_		8	OUANTITY	1	MATERIAL		2	TTD LABOR MM .	SUBCONTRAC
					MEO	TOTAL	83	5	1	E S	TOTAL	cost
EA. 70/	RAFFINATE	0	OLCR									
SIZE-IN. DAL	men D/L	8	TYPE DOUBLE	E PITE	7				_			
WO SHELL/SERV.	NV. / SOFT/SHELL	SMELL	TOTAL SOFT 50	O REPR		SOFT	00/	96	200			
NO-SHELL/SERV.	HV. m2/EHELL	#II	TOTAL m2	/SE PV		£W						
	SHELL SIDE C.A.	-	TUBE SIDE C.A.	Sep.						Н		
TAT	57		57							$\vdash$	$\vdash$	
DES PRIESS	130 1816	1	130 msig/	-							-	
DES TEMP	250 04	8	1	۶						_	-	
TUBES: DIA	CA MINI AV	3	EXP SMLS TEXP JOINT	j							_	
TUBE ENDS:	TUBE ENDS: WELDED []NO. TUBES [	Π	יַם	RECT. WT		TONSEA				_	_	
20/ 43	LEAN /RICH	7705	ENT EXCHANGER	2						_		
12 SIZE-IN. DAL	-	, -	TYPE AE	~					=	-	-	
NO SHELL/SERV.	ERV. 2 BOFT/SHELL	SHELL Z	SC TOTAL SOFT 56	SOMERV		SOFT	20-	0//	020	_		
NO SHELL/SERV.		HELL	TOTAL m2	SERV		m2				Н		
	SHELL SIDE C.A.		TUBE SIDE C.A.	1					-	L		
MAT	62		6.5									
DES PRESS	150 PSIG	e y	3 10 PSIG	Curyan								
DES TEMP	/m 082	န	340%	٥								
TUBES: DIA	3/4 CA MIN C AV	MELDE	ED SMLS CENT LOINT	rO						Н		
TUBE ENDS:	TUBE ENDS: WELDED []NO. TUBES [		INSUL 🔀 EF	FRECT. WT		TONS EA						
EA: 703	STRIPPEK	KEL	BulleR		7							
SIZE.IN. DAL	4	mm D/L	TYPE NEW	X						_	-	
40 SHELL/SERV.	s /	34611	211	30 ISERV		SOFT	20.	5	80	1		
40 SHELL/SERV.	NV. m2/5HELL	113+	TOTAL m <sup>2</sup>	SERV		m.				4		
	SHELL SIDE C.A.		TUBE SIDE C.A.	<b></b>						_		
AAT	<b>6.5.</b>											
DES PRIESS	15° mic/	Carried Control	635PSIG/	La September								
DES TEMP	40004	<b>3</b> 6	150 522	၁								
TUBES: DIA	3/4 GA MIN CO 4/E	WELL	TED SMLS TEXP JOINT	10								
TUBE ENDS:	TUBE ENDS: WELDED COND. TUBES		INSUL <b>E</b>	ERECT. WT		TONS EA						
TOTAL THIS PAGE	PAGE									H		
TOTAL ACCOUNT	DUNT											
CLIENTAN	91	PLAINS C	GASIF. PLANT	PROD FACT	t:	LOC. M.H.			72	10/0/	JOB 100.	1155
PROJECT J	MONECT JET FUEL FROM COAL THEOLED LIBUIDS	KIR W	1K07A	WAGE RATE	<u></u>	LAB. COST	_		DATE / C/	200		
			- LV.		$\left. \left  \right  \right $							

ESTIMATE SHET  CONDCINS (1987)  NIT TYPE  LELL TOTAL SOFT 2.0.0 KEW  CONDCINS (2.0.0 KEW)  TOTAL SOFT 2.0.0 KEW  TOTAL SOFT 2.0.0 KEW  TOTAL SOFT 2.0.0 KEW  TOTAL SOFT 0.0 KEW  TOTAL SOF	SECURITY   SOUTH   STANDED   SOUTH	THE LIBERT COMPANY	Beamflete	STD LABOR MR. SUB	LANT TOTAL			000										8								000										1222 mor 7/1 M
ESTIMATE SHEET  CONDCINS C.	### ESTIMATE SHEET    DESCRIPTION   CONDENS			L	_	+	7	2-0	\ \ \								<b>†</b>	2	1							3										
ESTIMATE SHI  CONDCINSER  LONDCINSER  HELL TOTAL M2 1200 SERV  HELL TOTAL M2 1200 SERV  OC 175 OF OC OC  OC 175 OF OC OC  OC 175 OF OC OC  ON TYPE SIDE CA. MMM  THE SIDE CA. MMM  THE SIDE CA. MMM  THE SIDE CA. MMM  THE SIDE CA. MMM  INTER. TOTAL M2 SERV  NATER. TYPE STABLES-IA. 8-U  ON TYPE STABLES-IA. 8-U  ON TYPE STABLES-IA. 8-U  NATER. TOTAL M2 SERV  OC 775 OF OC  OC 775 OC  OC 77	ESTIMATE SHI  DESCRIPTION  STRIPES CONDENSES  FINATE SHI  SOFTSHELL  SOFTSHELL  FOR LAND  FOR LA		<b>-</b>	MENTY	¥		╡	E	Sm2						TONS EA			1308	2				#		TOMSEA	+	THOS	260						TONSEA		70.00
CONDCNS € A  LONDCNS € A  RELL TOTAL SOFT  ELL TOTAL SOFT  RELL TOTAL M2  LONDCNS ESIDE CA.  LONDCNS ESIDE	DESCRIPTION  STRIPPER CONDENSER  BOTTSHELL TOTAL SOFT  BOTTSHELL TOTAL SOFT  C. S.  C.	700/JA	STIMATE SHEE	8	REO		E 3	ő		unu			30		֡֓֓֞֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֓֓֡֓֓֡֓֡֡֡	/		GO ISERV	1	- mm	INNED TUBES	1.5%	3	$\neg$	ERECT.		She.	\$	- Land	10	100/20	30		TANO	EMECT: WI	-
	DESCRIPE  STRIPE  STRIPE  SO OF  SO O					57.	TVPE	٦٢		TIME SIDE C.A.	1000 300	,	۲ ا	2			3	TOTAL SOFT	TOTAL m2	TUBE SIDE C.A.		635	12/2	SMLS [] EXP	ב	REBOI	TYPE STA	TOTAL SOFT	L	TUBE SIDE C	100/1	027	775 mt	U SAALS I EXP	뮋	
	ENV.  FIN.  STRIFE  STRIFE  STRIFE  SERV.  S	PROFIT			DESCRIPTION		15		The House La	N. Carrie	1					13	1 1		SO FT/SHELL				2	1		1	mm D/L	SO FT/SHELL	2/SHELL	1	1			¥		

700mm

ACC A122 10814 REV. 2 SUBCONTRAC 5 THE LUMBEL COMPANY 8 5571 **Hooms** STD LABOR IM EST NO. TOTAL DATE 12/18/87 1 W 100 3000 000 MEV. Space MATERIAL 5051 -8/ 81 COST SOFT SOFT É SOFT **LAB.** COST È TONS EA TOMS EA TONS EA LOC. M.H. TOTAL **OUANTITY ESTIMATE SHEET** REO WAGE RATE PROD FACT 725 BERN /SE FIV SERV Ē SERV ŧ Ē ٤ TOTAL SOFT / 40 ISERV ERECT, WT ERECT. WT SU BERV ERECT. WT ٧ TYPE BKU (MOD) TUBES: DIA 3/4" GA MIN O AV WELDED SALS CENT JOINT WELDED | SMLS | EXP JOINT | 19 TUBES DIA 3/4 GA MIN AV WELDED SALS EXP. JOINT AES REBOILER CONDENSER TOTAL SOFT TOTAL SOFT TUBE SIDE C.A. TUBE SIDE C.A. C. ND. TUBE SIDE C.A. TOTAL m2 PROJECT JET FUEL FROM COAL DECIVED LIQUIDS TOTAL m2 TOTAL m2 CLIENTAMO CO DOE-GREAT PLAINS GASIF. PLANT V TYPE . 130 PSIG 130 msic 310 PSIG 40004 INSUL M | MASUL | 125 LOCATION BEULAH, NORTH PAKOTA COLN EJECTUR WATER STRIPPER COLUMN E DESCRIPTION ۲ Ē ړ SO FT/SHELL SO FT/SHELL SO FT/SHELL m2 SHELL m2/SHELL m / /SHELL **10 11 11** MM 0/L 70 1 34 GAMM AV TO TUBE ENDS: WELDED | NO. TUBES | TUBE ENDS: WELDED | MO. TUBES | TUBE ENDS WELDED []NO. TUBES RECOVERY SHELL SIDE C.A. SHELL SIDE C.A. SHELL SIDE C.A. SUMMUS -75 PSIG 75 mg 75 PSIG 300 % 1 052 RECOK. 250 00 TOTAL THIS PAGE TOTAL ACCOUNT NO SHELL/SERV. NO SHELL/SERV. NO SHELL/SERV. NO SHELL/SERV. NO SHELL/SERV. HO SHELLISERY. PURES DIA 1251ZE-IN. DAL 22 SIZE-IN. DVL 17 DES PRESS 21EA. 709 DES PRESS SIZE-IN DA DES PRESS EA. 708 EA. 707 10 DES TEMP 20 DES TEMP DES TEMP TAMO

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	IS SLUMMUS		ES	ESTIMATE SHEET	HEET				ř	THE LUMBL. COMPANY Bosenited	COMPANY Wed
					QUANTITY	135	MATERIAL	יאר	STD LABOR MA	. 3	SUBCONTRAC
,		DESCRIPTION			REG TOTAL		COST		Lour 1	TOTAL	<b>203</b>
1 EA. 710	SOLVENT	200 EN	ERATOR REBOILER	ונפער	/						ļ.
2 SIZE-IN DAL			TYPE STABBED-IN	6-1N 8-0							
3 NO SHELL/SERV.	ERV.	SO FT/SHELL	TOTAL SOFT /	O ASERV		SOFT	3	200			
4 HO SHELL/SERV.	ERV.	m <sup>2</sup> /3HELL	TOTAL m2	/SE FIV		ČE.		-	<u>                                     </u>		
	WHELL SIDE C.A.	C.A. / mm	TUBE SIDE C.A.	THE STATE OF							
PAAT	MUCTOS		CS (FINNED	1.2 7.8 E.							_
7 DES PRESS	/Susa	(2)	635 msic/	Can supply							
DES TEMP	3.0		775 06/	ာမ							
PTUBES DIA 3/4		GA IMM C AV C WELDED	SMLS EXPLOINT	ים		_					
TUBE ENDS:	TUBE ENDS: WELDED []NO. TUBES [		8	ERECT. WT	TOP	TONS EA			_		
11 EA 711	SOLVENT	M COOLER						=			
12 SIZE-IN. DAL		mm D/L	TYPE AE	۶ ا							
13 NO SHELL/SERV.	ERV. /	SO FT/SHELL	TOTAL SOFT 186	6 ASERV	S	SOFT 20-	4/2	000			
14 NO SHELL/SERV	ERV.	m246HELL	1	SERV		m2		_			
Ŧ.	SHELL SIDE C.A.	C.A. mm	TUBE SIDE C.A.	WELL .					-		-
96 MAT		52	6.5.								
17 DES PRESS	310 0510	(12 mg/s)	/30 PSIG	C							
10 DES TEMP	4000	1	175 00/	٥٥							
19 TUBES: DIA	3/4- GA MIN	O AV O WELDED	C SMLS C EXP JOINT	_ 							
20 TUBE ENDS	ZO TUBE ENDS WELDED MO. TUBES		INSUL	ERECT. WT	10	TONS EA					
272.434	C1.AX 7	TWR. FEED/E	EFFL EXCHANGEN	<i>-</i> γ	7						
72 SIZE-IN DAL		nem D/L	TYPE AE	>				=			
23 NO SHELL/SERV.	ERV. /	SO FT/SHELL	TOTAL SOFT 75	/ SERV	s	SOFT					
24 NO SHELL/SERV.	EMV.	m <sup>2</sup> /SHELL	TOTAL m <sup>2</sup>	SERV		m2 16-	1	000			
2	SHELL SIDE C.A.	C.A. / mm	TUBE SIDE C.A.	mate		X.					
28 MAT	2	5	<b>CS</b>								
27 DES PRESS	365 1810	Carried /	365 ms16/	Cm3400							
28 DES TEMP	360 00		430 00/	န		-					
29 TUBES: DIA	2	GA MIN CO AV WELDED	CD SMLS CXP JOINT	o.				H	-		
20 TUBE ENDS	TUBE ENDS: WELDED THES		MSUL)X	ERECT. WT	TOP	TOWS EA					
TOTAL THIS PAGE	PAGE										
TOTAL ACCOUNT	DUMT								Н		
CLIENT AMOGO	•	Boe-GREATPLAINS GI	GASIF. PLANT	PROD. FACT	LOC. M.H.	E.E.		N 111		2 ON 80'	271 ACCT
LOCATION PROJECT 7	1.6	BEULAH, NORTH DA	TH PAKOTA	WAGE RATE		I AB COST		DATE /2/	187		
		ממה מכיסו	7700						,		

				ESTIMATE SACCT	שבנו				:	!	Phonditte Beomitett		
					ş	QUANTITY	185	MATERIAL		STO LABOR MA	[.	SUPECIALIBAC	1
		DESCRIPTION			REO	TOTAL	COST	COST	185	IT TOTAL	3	205	
EA. 7/3	CLAY TOWER	ER FEEL	D HEATER										
SIZE-IN DA		mm D/L	TYPE DOUBL	21/1 30									
NO SHELL/SERV.	\	SO FT/SHELL	TOTAL SOFT	20 NEW		SOFT	100	9	0				
D SHELL/SERV.		m <sup>2</sup> /SHELL	TOTAL m2	/SE AV		Z.W		_	-	<u> </u>			
	BHELL BIDE C.A.	um.	TUBE SIDE C.A.	E .									
AAT.	65		SO										L
DES PRIESS	470 PSIG	2.3	635 mic/	Care and	-				-				
DES TEMP	450 00	g		၁	T				-	-			
TUBES DIA	몓	AV () WELDED	O SMLS C	DINIO					L				
UBE ENDS:		IU	20.20	ERECT. WT		TONSEA							
EA. 7/4	RENZENE	770	1 REBOILER		F				L				L
SIZE-IN. DAL	Į <b>•</b>	man DAL	TYPE B	00						_			
NO SHELL/SERV.	-	SO FT/SHELL	TOTAL SOFT /	SO BERV		\$0 FT	-50	380	2	_			
WO SHELL/SERV		m <sup>2</sup> WEHELL	TOTAL m2	SERV		Cm2							
	SHELL SIDE C.A.	-	TUBE SIDE C.A.	- L	_								L
MAT	65		C S										
DES PRESS	15 ms/c	C1249	635 ms16	(2.50									
DES TEMP	360 %	20	126 366	<u>د</u>									
TUBES: DIA	JVA [] MN Q	V 🗌 WELDED	O SMLS   EXP JOINT	NT []									
UBE ENDS:	20 TUBE ENDS: WELDED   NO. TUBES	S	Z Z	ERECT. WT		TOMSEA							
S12 VI	BENZENE		ICT COOLER		1								
SIZE-IN. D/L		mm D/L	TYPE DOUBLES	68 673				2000	2				
10 SHELL/SERV.	/	80 FT/SHELL	=	75 ISERV		SOFT							
IO SHELL/SERV		m <sup>2</sup> /SHELL	TOTAL m <sup>2</sup>	SERV		Tw.							
	SHELL SIDE C.A.	- unu	TUBE SIDE C.A.						_				
AAT	65		57										
DES PRESS	100 PSIG	200	/30 msic/	(1) A									
DES TEMP	25000	သူ	125 05/	သိ									
TUBES: DIA	GA MIN C AV WELDED	A 🗆 WELDED	C SMLS C EXP	DINIOL [									
TUBE ENDS:	TUBE ENDS: WELDED THES		]INSOL[]	ERECT. WT		TONSEA							
TOTAL THIS PAGE	PAGE												
TOTAL ACCOUNT	OUNT												
CLIENTAM	CLIENTAMOCO DOE-GREAT PLAINS GA	TPLAINS GI	ASIF. PLANT	PROD FACT	-	H M 301		AB	mr.	eor	5 0	123	ACCT
LOCATION	LOCATION BEULAH, NORTH PAKOTA	ORTH PA	(677		+		1	DATE		12/18/87			<b>S</b>
つしばの社	し ドクロー イズの 一つ	040 DEDW	10 1/00/DS	WAGE MATE	_	<b>78. COST</b>	_	# PE >	) >			•	

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E SLUMBERS	MUS			ESTIMATE SHEET	SHEET						2 3 T	THE LUMBAL JOHNANY	HEARY	
	DESCRIPTION	¥			ğ	OUANTITY	LMST	MATERIAL	1	Ē	STD LABON NEW			Į
	•				٤	TOTAL	COST	8		-THO.	TOTAL	_		
2// SATE 1841	DENTICHE COLON	2MV		EK	7				H			-	$\vdash$	Γ
AND SHELL/SERV	/ SO FT/CHELL		A 20101	J)	7								-	$\Gamma$
The Court of the C	7		TOTAL SUFT 4	K	1	SOFT	10	7	000				-	Γ
OND SHELL/SENV.	M-/SHELL		TOTAL m2	/SE AV		<b>E</b>			-		<del> </del>		+	T
	PHELL BIDE CA.	E E	TUBE SIDE C.A.	unua /				f	f	t	1	+	+	T
7		_	65		-			<del> </del>	f	$\dagger$	1	+	$\dagger$	T
		/ least	30 1516	200				$\dagger$	t	$\dagger$	$\dagger$	$\frac{1}{1}$	+	T
- 1		7 3	130 51	ၓ				-	t	$\dagger$	1	+	$\dagger$	Τ
		WELDED []	SARLS   EXP. JOH	DINIOL				-	F	$\dagger$	+	ŧ	+	Τ
5]		] wsw[		ERECT WT		TOWS EA		$\dagger$	+	$\dagger$	+	+	+	T
"EA 717 786	TOLUENE COLUMN	MM	REBOILER					$\dagger$	t	$\dagger$	+	Ŧ	+	T
12 SIZE-IN. DA.	men D/L		TYPE BE	3				$\dagger$	ŧ	$\dagger$	$\dagger$	+	+	T
	/ SOFT/SHELL		TOTAL SOFT 7	70 ISERV		1308		1	18	$\dagger$	+	+	+	T
94 NO SHELL/SERV.	MARCH		TOTAL m2	SERV	-	ZE		<del>-</del>	+	$\dagger$	$\dagger$	<u> </u>	+	7
אפור	SHELL SIDE C.A.	man TL	TUBE SIDE C.A.	-	-			$\dagger$	$\dagger$	$\dagger$	+	+	+	T
MAT	~		C 5.		-			$\dagger$	t	+	$\dagger$	+	+	T
\$ 75		9	35 ms	-				-	+	$\dagger$	$\dagger$	+	+	T
DES TEMP	L	27	130 51	သူ	-			$\vdash$	+	$\dagger$	+	+	+	T
TUBES: DIA 3/4 G.	<b>E</b>		SMLS C EXP JOHNT	ינם				$\dagger$	┝	-	$\dagger$	+	+	T
LUBE ENDS: MEL		Imsur X		ERECT. WT		TONS EA		-	-	$\vdash$	╀	L	+	T
87.Z.A	XYLENG PRODUCT		COOLER		1 /			$\vdash$	<u> </u>	-	$\parallel$	+	+	T
_	men D/L		TYPE DOUBLE	E PIPE	_			3	8	$\vdash$	-	-	+	T
_	/ SOFT/SHELL		TOTAL SOFT S	M		SOFT		-	H	$\mid$	ig	-	+	T
NO SPECIASEM	שיינאיפור		TOTAL m2	SERV		240			┝	$\vdash$	-	-	+	T
	PIELL SIDE C.A.	2	TUBE SIDE C.A.	ww /				$\vdash$	F	$\vdash$		<u> </u>	-	T
MAT	200				_			$\dagger$	t	+	+	╀	+	T
Des mess 75	210	130	E.	Caraca				-	+	}	+	-	╀	T
DES TEMP 30	, ,	°C 1/7	) ot/	န				-	F	-	+	+	$\downarrow$	T
29 TUBES: DIA . GA	GA MIN AV WELDED		SALS   EXP JOHNT	D.				-	f	$\dagger$	+	1	+	T
20 TUBE ENDS: WELDED []NO. TUBES	Ono. tuees	JIMSUL []		EHECT. WT.	+	TONSEA	1	$\dagger$	╪	$\dagger$	+	+	+	T
TOTAL THIS PAGE					t		†	$\dagger$	╪	$\dagger$	+	<b> </b>	$\downarrow$	Т
TOTAL ACCOUNT				<b>†</b>	+		$\dagger$	+	+	$\dagger$	$\frac{1}{1}$	+	+	T
CLIEM AMOCO DE	CLEMANO CO DOE-GREAT PLAINS GA	J1549	PLANT	PROD FACT	L	777		6	1/4	┨.	100		Tov Tov	TE
LOCATION BEEU	BEULAH, NORTH PAK	PAKOTA			1	LOS. W.T.			2/3	1.8/87	£57 MO.	5571		
PROJECT JET FUE	MONECT JET FUEL FROM COM. DECIVED LIQUIDS	OVED L	100105	WAGE RATE		LAB. COST		REV					<b>5</b>	
														٦

C. ET MAX PROFIT

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N M		ء م	ES	ESTIMATE SHEET	SHEET						THE LUMMUS COMPANY	Mbs com	<b>VARY</b>
				F	₩ W	QUANTITY	185	MATERIAL	1	2020	Ī	Carry .	A STANCE OF THE PARTY OF THE PA
		DESCRIPTION	_	<del></del>	REO	TOTAL	COST	COST		Last	TOTAL	T	7505
EA. 7/9	TOLUENE	MW OTOD SI	CONDENSER										H
2 SIZE-IN. DA.		1	TYPE H	ES									
3 WO SHELL/SERV.	AV. /	SO FT/SHELL	TOTAL SOFT 7	5 BERV		SOFT		26	000				Н
MO SHELL/SERV	W.	m <sup>2</sup> /BHELL	TOTAL m <sup>2</sup>	/SE PIV		m <sup>7</sup>							
	SHELL BIDE C.A.	C.A. / mm	TUBE SIDE C.A.	unu /									Н
TAT.	۷		57										Н
DES PRESS	584 SZ		/3 o PSIG/	Carry Ma									
DES TENP	3050		175 04/	٥٥									
TUBES: DIA	3/4 GA MIN CO AV	O AV O WELDED	D SMLS TEXP JOINT	10					-				
10 TUBE ENDS:	TUBE ENDS: WELDED []NO. TUBES		O	ERECT. WT		TONSEA							
024 230	TOLUENE	PKE	DUCT COOLER		1/				=				Н
12 SIZE-IN. DAL		Ī	ENE DOUBLE	3 P/RE									Н
13 MO SHELLSERV.	MV.	BO FT/SHELL	TOTAL SOFT 3	O BERV		SOFT		3	200				Н
14 PATO SHELL/SERV.	EMV.	m2 WHELL	TOTAL m2	SERV		m <sup>2</sup>				Н			$\sqcup$
2	SHELL SIDE C.A.	C.A. / mm	TUBE SIDE C.A.							_			
MAAT	2		52					+	+	-	-		$\dashv$
17 DES PRESS	150 mg	,	130 msic/	-} **					+		-		$\dashv$
NO DES TENP	25000	) •	175 %	န	+				1		-		4
19 TUBES: DIA	OA MIN	אם אברם	ED SMLS CEXP JOINT	D D	+			+	+	+	-	-	4
TUBE ENDS:	20 TUBE ENDS: WELDED   NO. TUBES		IMSUL [	FRECT. WT	+	TONS EA		+	+	+	+	-	┥
21 EA					1			+	+	+	+	+	+
22 SIZE-IN. DAL		mm D/L	TYPE		1				1	-	-		$\dashv$
23 NO SHELL/SERV.	INV.	SO FT/SHELL	TOTAL SOFT	SERV		SOFT							$\dashv$
24 NO SHELL/SERV.	MV.	m <sup>2</sup> /SHELL	TOTAL m <sup>2</sup>	SERV		m2		+	+	+	-		$\dashv$
R	SHELL SIDE C.A.	C.A. / mm	TUBE SIDE C.A.	Live I					=	1		1	$\dashv$
28 MAT					+			1	7	+	+	4	+
22 DES PRESS	PSIC	مشيئها كز	Ľ	1					=	1	1	4	$\dashv$
28 DES TEMP	54a		) de	န					=				$\dashv$
29 TUBES: DIA	NAM AD	GA MIN C AV WELDE	FD SMLS TEXP JOHNT	10					==			_	┥
30 TUBE ENDS	TUBE ENDS WELDED THES		INSUL []	ERECT. WT		TONS EA							-{
TOTAL THIS PAGE	PAGE	·									1	1	+
TOTAL ACCOUNT	DUNT				┧			1	╡	1	4	4	4
CLIENT AMOCO	1000 PoE-	DOE-GREAT PLAINS	GASIF. PLANT	PROD. FACT	-	LOC. M.M.		-1.			£57 80	1255	§ 5
PROJECT JE	ET FUEL FA	PROJECT JET FUEL FROM COAL DIFOVED LIBUIDS	PAKOTA	WAGE RATE		LAB. COST	_		DATE 19	2 2 3			; 
		222	1100 1100		}								

A122 1081-8 NEV. 2

A172 1081-8 REV. 2

	PREIT 700	ARÉA								
CONTINUED   CON	ESTIMATE ESTIMATE	SHEET						THE LUA	MAUS CO	ANV
10   10   10   10   10   10   10   10	DESCRIPTIO	JANTI		UNIT	MATER	<b> </b>	8	LABOR MH	2	ONTRA
	Tol GEED CHREE		$\dagger$	<u>.</u>	3	$\dagger$	<u> </u>	TOTAL	+	
	10 10 10 10 10 10 10 10 10 10 10 10 10 1	2		7		1	T	+	+	+
### C S. CLOD   LINING   CA    #### C S		2 /	3			3		+		╁
STATE   STA	MAT C S. CLAD LIMING CA				T	T			-	$\vdash$
NERVESTOR   1000   CITRES REL   FABSONO   1 100    NERVESTOR   1000   CITRES REL   1 100    NERVESTOR   1000   1000   1000    NERVESTOR   1000   1000   1000   1000    NERVESTOR   1000   1000   1000    NERVESTOR   1000   1000   1000   1000    NERVESTOR   1000   1000   1000   1000    NERVESTOR   1000   1000   1000    NERVESTOR   1000   1000   1000    NERVESTOR	So PSIG DESTEMP 250		-						-	-
NEW COLOR   STRIPPEZ RELUCATION   TOWS   TOWS	APP.2 DESTEMP									├
HERLING HORIZ   Vert   Spring   Free   The Free   Tooks   Free   Tooks   Free   The Free   Tooks   Free   The Free   Th	HOP   FIELD					Ħ				H
HERLE HORIZ VERT B PHERE LAND DRUIN 1 TONS 14.702 CAND LINING CAND AND AND AND AND AND AND AND AND AND	YORTEX					1				
14. 70.2	HORIZ   VERT   SOVERE		SNO	+		Ħ	T		+	+
	STRIPPER REFLUX DRUIN	-	<del> </del>	T		T		-	┡	
MAT C S CLAD □LIMING □ CA 1/8	1'-6" 10 //'-0" TK	920	Ŀ	3-	9	8		-		$\vdash$
NATE C.S. CLAD   LINING   C.A. 1/9 t   mm    DES PRESS  SO			<u> </u>							$\vdash$
065 PRESS  XARAY-SOT   100M   25 Co to	CS CLAD DUMNG CA 1/8" /		-			F				-
WATENALS:   1000   1	SO PSIG DESTEMP 25									
NATEHOLIS   1004   STRESS REL   FABSHOP   STREED     NATEHOLIS   1104   STRESS REL   FABSHOP   STREED     1894   1895   1895   STREED     1894   1895   STREED   STREED     1895   1895   STREED   STREED   STREED     1895   STREED   STREED   STREED   STREED     1895   STREED   STREED   STREED   STREED     1895   STREED   STREED   STREED   STREED     1895   STREED   STREED   STREED   STREED     1895   STREED   STREED   STREED   STREED   STREED     1895   STREED   STREED   STREED   STREED   STREED     1895   STREED   STREED   STREED   STREED   STREED   STREED     1895   STREED   STR	DES PRESS bytem DES TEMP									$\Box$
	7 X-MAY-SPOT   100%   STRESS REL   FAB-SHOP TO FIELD									
	A KELY									-
FA 20.3 RECOVERY ColuMN REFLUX PRUM  I'-6" 10 20'-0" TT TK SKIRTHT    I'-6" 10 20'-0" TT TK SKIRTHT   I'-6" 10 20'-0" TK SKIR	18 dx 2'15- BooT				1				4	4
1'-6"   10   20'-0"   T   TK   SKIRT HT   INCOMING   20'-0"   T   TK   SKIRT HT   TK   SKIRT HT   TK   SKIRT HT   TK   SKIRT HT   TK   TK   TK   TK   TK   TK   TK	WERE []		SNO							
	COLUMN REFLUX					7			1	
MAT C S CLAD   LWING   CA \( \lambda \rightarrow \rig	7.6. 10 20'-0" T	2000				8		1	+	$\dashv$
DES PRESS  SERVICES  SERVI			$\dagger$	1	$\dagger$	†		1	+	+
NATERIAL STRESS REL FABSHOP & PERCT. WT.  NEWL HORIZED VENT SHOPE FIELD  NOTE ACCOUNT  CLIENT AMOLD DOE - GREAT PLAINT GASIF. PLANT  LOCATION BE ULAH, NORTH DAKOTH  PROPERTY FOR COAL DE 2014. AND THE DAY OF THE PROPERTY COST  NATURAL SHOPE STRESS REL FABSHOP & PLANT  NATURAL SHOPE STRESS REL FABSHOP STRESS RESPONSE REL SHOPE STRESS	DES FREES SO PSIG DES TEMP 7 CA		+	1		t	1	+	+	╀
NYTERNALE: DIPLES THESS REL   FAB-SHOP   FIELD    NYTERNALE: DIPLES TVILTEX BKR,  18° & × 2'-C"7-7 36°7.  NSUL   HONIZ   WARTH   SHFERE    TOTAL THIS PAGE  TOTAL THIS PAGE  CLIENT AMOLD   DOE - GREAT PLAINT   PRIOD FACT    LOCATION   BEULAH, NORTH DAKOTH    LOCATION	DES PRESS					Ī	Ī		+	+
WEENINGLE   1/2/65   VICTEX BKR,	X-RAY-SPOT   100%   STRESS REL   FAB-SHOP   FIELD			T		Ħ	T	<del> </del>	L	$\vdash$
18° 4 × 2° - 6" 7-7 36° 7.  INSUL □ HORIZ B VENT □ SHPERE □  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOCO DOE - GREAT PLAINT GAS/F. PLANT  FROME THE CUELL FROM COAL DESIVED. LIGHTON 100,005  TOTAL ACCOUNT  CLIENT AMOCO DOE - GREAT PLAINT GAS/F. PLANT  FROME THE CUELL FROM COAL DESIVED. LIGHTON 100,005  TOTAL THIS COST.  TOTAL ACCOUNT  TOTAL ACCOU	INTERNALS: DIPLES & VILTEX B								-	
TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  TOTAL ACCOUNT  TOTAL THIS PAGE  CLIENT AMOLO DOE - GREAT PLAIN'S GASIF, PLANS  LOCATION BE-ULAH, NORTH DAKOTH  TOTAL CO. M.H.  BY 11/1.	18°4 × 2'-6"7-7 300T.									
45 GASIF. PLANT PROD FACT LOC.M.H BY 1/1/2. LOB NO. 5571 DEPLOY MAGENATE LAB COST REV	MISUL   HOMIZ   VENT   SHPERE		rows							
DOE-GREAT PLAIN'S GASIF, PLAIN' PROD FACT LOC. M.H. BY 11/1. LOB NO. 5571  EULAH, NORTH DAKOTH MAGERATE LOC. M.H. DATE 12/14/12 EST NO. 5571	TOTAL THIS PAGE									
MY GASIF. PLANT PROD FACT LOC.M.H. BY 11/1. JOB NO. 5571  DAKOTA DESINED LIGHTON WAGERATE LAB COST BEV										
DESIGNATION WAGE RATE LAB COST REV COST	DOE-GREAT PLAINS GASIF. PLANT		. M.M.			// ve		EST		_
	DEPLYED LIMITED		rsos			<b>\</b>	<u>}</u>	_		т

CASE 7 MAX PRAFIT

ESTIMATE SHEET	SHEET					THE LUMBAR	THE LUMBIUS COMPANY Bloomfield
	OUANTITY		FINS	MATERIAL	Ē	CABON ME	SUBCONTRAC
DESCRIPTION	REO	4	COST	COST	1887	5	2005
184704 EJECTOR CONDENSATE DRUM	_			,			
1'-C"10 4'-0" TT TK	/00	o LBS	4-	1000			
3 m 🗆 mm 🗇	t						
C CLAD □LINING □ CA 1/8" /							
SO PSIG DESTEMP 250							
DES PRESS	-						
7 X-RAY-SPOT   100%   STRESS REL   FAB-SHOP ED FIELD							
BINTERNALS: 3 BAFFELS, INT. PIPE DISTAIR.							
						-	
TO INDULES HORIZES VERT SPIERE		TONS					
SOLVENT				1			
8:0"10	20	SET OF	21	Apac			
HIMAT CS CLAD LIMING CA / mm							
NE DES PRESE			[				
00 THESE DESTEND OC							
17 X-RAY-SPOT   100% STRESS REL   FAB-SHOP   FIELD							
INTERNALS LEVEL BIRGLER , 3'-0" ID NECK 2' T-T							
10 CUATED AND WEAPPED FOR BURIAL.							
E		TONS					
MEAZOG VENT KO DRUM	1. [						
2	20	S <b>81</b> 00	4-	$\mathcal{E}_{boc}$	,		
MAT 65 CLAD DLINING CA 1/9" / mm							
28 DES PRESS							
Des Priess   National Priest   Des Temp   Oc							
77 X-RAY-SPOT [] 100% [] STRESS REL [] PAB-SHOP [S] FIELD []							
20 INTERNALS:							
THENTTRACED. BATTOM MY							
MINSUL IN HORIZ VERT IN SHPERE		TONS					
TOTAL THIS PAGE							
TOTAL ACCOUNT							
CLIENT AMOCO DOE-GREAT PLAINS GASIF. PLANT PROD FACT		M M DOI		A	1116.		CC2/ Acct
				DATE	13/16	- 1	٦L
PROJECT JET FUEL FROM COAL DERIVED LIQUIDS WAGE HATE		LAB. COST		REV	יפ		
						<	A122 1081 8 REV. 2

A122 1081-8 RFV. 2

ACCT SUBCONTRACI 2 THE LUMBIUS COMPANY 200 LEST NO. 5571 **Moornfield** STD LABOR MH TOTAL DATE 12/18/87 **T#5** J Loop 0000 REV MATERIAL COST <u>}</u> 250 COST 1, LBS 8000185 LBS LAB. COST TONS TONS LOC. M.H TONS 2000 OUANTITY REQ EA Ę **ESTIMATE SHEET** WAGE RATE PROD, FACT SKIRT HT E SKIRT HT Ē SKIRT HT Ę 10 ENECT. WT ၂ပ ERECT. WT. PSIG DESTEMP 2500F ပ္ ERECT. WT. ů PSIG DESTENP 250 OF MOCATION BENCHH, NORTH DAKOTA
MOLET JET FUEL FROM COAL DERIVED LIGHUDS PSIG DES TEMP Been DES TEMP MET DES TEMP LAND DES TEMP 12-0" 10 7-0"TR TK CLIENT AMOCO DOE -GREAT PLAINS GASIF. PLANT DRUM X-RAY-SPOT | 160% | STRESS REL | FAB-SHOP SFIELD | X-RAV-SPOT | 100% | STRESS REL | FAB-SHOP | FIELD | X-RAY-SPOT | 100% STRESS REL | FAB-SHOP SFIELD ,,8/ CLAD [LINING ] CA 1/8" ¥ WITH 18 4x2 TTBOIT AND DIPPIPE 11 FA 708 BENZEME COLN REFLUX

12 4-0" 10 17-0"TT 50 20 CLAD CLIMING CA S DESCRIPTION CLAD CLINING F MSUL HORIZED VERT SHPERE MBUL HORIZ BY VERT SPHERE ŽŽ MTERNALS: DIPPIPE 0 って 5 TOTAL THIS PAGE TOTAL ACCOUNT INTERNALS: INTERNALS: CASE 26 OES MESS 28 DES PRESS DES PRESS DES PRESS 6 DES PRESS HOES PRESS 13 mm Danies 22 m | mm TAMAT ž ¥ R > /:

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CASE 7 MAX PROFIT

ESTIMATE SHEET	SHEE					THE LUM	THE LUMMUS COMPANY	È
	9	OUANTITY	LINI	MATERIAL	=	2		
DESCRIPTION	REO	Æ	COST	COST	] \$		COST	TAACT F
198701 SOLVENT STORAGE TANK	-			-				
13'-0"10 13'-0"TT TK								
3 mC mm C								T
AMAT CLAD LINING CA 1/8" / mm								
6 DES PRESS PT NOS PSIG DESTEMP 120 OF								
DES PRESS hg/cm <sup>2</sup> DES TEMP OC				-				Τ
7 CAPACITY: 300 BARRELS/ GALLONS/ MJ			100	-			3	
TINS COIL				-	-		4	1
ľ								
19 INDUL BAN BOULLET   FABSHOP BFIELD		TONS		-				T
" FR JOZ WET SOLVENT STARAGE TANK	-			-				T
1.0" 10 9'-0" TT TK								
								Γ
14 MAT CS CLAD LINING CA 1/8" / mm					-			Ţ
ATMOS PSIG DES TEMP 120								T
10 DES PRIESS 1600 PC				-				
100 BARRELS			150	Server of				
				~~				
18 TYPE: CR   FR BOR   SPHEME   OTHERS   HORIZ   VERTS				-		-		
20 INSUL BLAM BOULLET OF ABSHOP BIFELD OF ERECT. WT		TONS						
FP 703 CCAY								
ут п,о-,2/				  -				
				_				
20 CLAD LINING CA 1/8 / mm						-		
20 OES PRESS ATMOS PSIG DES TEMP /20 OF				_				
27 CAPACITY: 250 BARRELS/ GALLONS/ NJ			3				256	8
20 INTERNALS							-	
29 TYPE: CR ☐FR MOR ☐ SPWERE ☐ OTHERS ☐ HORIZ ☐ VERT M								
38 INSUL [] API ES BULLET [] FABSHOP ESFLD[] ERECT. WT.		TONS						
TOTAL THIS PAGE							  -	Γ
CLIENT AMOLO (DOE-GREAT PLAINS GASIF. PLANT MOD FACT	5	LOC. M.H.	_	λg	1116.	ON BOL	, 1633	ACCT
MONECT JET FUEL FROM COAL DERVED LIQUIDS WAGE HATE	 	LAB. COST		DATE	E / 1//X/87			<b>£</b>
					,		4	]

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CAJE 7 MAX PROFIT

ESTIMATE SHEET	SHEE	-				I'ME L'UMMUS COMPANY Bioomfield	MIUS COMPA	<b>&gt;</b>
	00	QUANTITY	UNIT	MATERIAL	<b>1</b>	BTD LABOR MH	SUBCONTRAC	Į¥¥.
	REO	EA	COST	००	5	TOTAL	2081	
18 704 BENZENE DAY TANK				 				
7								
AMAT CS CLAD LINING CA 1/8" / mm								
S DES PRESS ATMOS PSIG DESTENT 120 OF								
hg/cm2 DES TEMP				_				
PCAPACITY: 320 BARRELS GALLONS MJ			8/	_			32	80
PTYPE: CR   FR BOR   SPHERE   OTHERS   HORIZ   VERT B				_				
10 INSUL   AM BEBULLET   FABSHOP BEIELD   ERECT. WT		TONS						
INTERIOR XYLENE DAY TRUK	\   			_	 			
4'-0" 10 7'-0"TT								
14 MAT CS CLAD LINING CA 1/8" / mm				_	_			
ATMUS PSIG DESTEMP			2/2	6				Γ
hg/cm² DES TEMP /20								
17 CAPACITY: 15 BARRELS GALLONS M3								
IS INTERNALS								
19 TYPE: CR 🔀 FR 🗌 OR 🔲 SPHERE 🗍 OTHERS 🗍 HORI Z 🔯 VERT 📋								
LET SPABSHOP SE		TONS						
MED JOGAFB TOLUENE DAY TANKS	4							
			100	12000	•			
MAT CS CLAD LINING CA 1/8" / mm								
TO DES PRESS ATMOS PSIG DESTEND / 20 OF								
hg/cm <sup>2</sup> DES TEMP								
20 CAPACITY: 120 BARRELS GALLONS M3								
38 INTERNALS								
29 TYPE: CN SS FR OR OF SPHERE OTHERS HORIZ VERT ES								
30 INSUL		TONS						
TOTAL THIS PAGE								
TOTAL ACCOUNT								
3	را	LOC. M.H.		AB	1111.	ON PO	1255	ACCT
MONECT TET FUEL FPON COAL DEPUNED LIQUIDA WAGERATE	- W	LAB. COST	_	BEV.	E 17/18/8	7		£
CAIDAN ASAINS	-	1	-			,	1 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	] [

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CA. : 7 MAX PROFIT

Control							3 2 2 2 2 2 2							THE CO	MANUS C	THE LUMMUS COMPANY	\_
Constitution   Community   Constitution   Constit		MUS				3	IMAIC	שעכ							Bloomfi	pid	
								9	ANTITY	TINO	MATER	٧٢	570	LABOR MI		UBCONTE	¥C.
		Š		2				REO	EA	COST	COST	<u></u>	UNIT	TOTAL		COST	
S   SUCT     S   S   S   S   S   S   S   S   S	1GA-701A \$5		FAR		DHING			2								-	
SUCT   WAS   STOCK   WAS   TEAM   COST	2 CPM / 5	`	Sign	5	Ē		1000E					8		-	-		
1	w <sub>2</sub> w		23	MSCH	200		၁										
CASE	15-63 4	3	Ŀ			<u> </u>	STGS					-			F		Γ
CASE   C.S.	•	40	E			e E	APPL					-					
CAST   State   Others   Othe	MAT: CASE	52	INPELL	R3.	H	2	12 HP					-			-	-	
CENT_B NECP   PROP   OTHERS   AND   AND				0			3					=			-		
	1 . '					تَ									=		
Cold   Sump Acound Pump   Dump   Cold   Superation   Cold   Superation   Cold   Superation   Cold   Superation   Cold   Superation   Cold   Superation   Cold   Cold   Superation   Cold   Co	2															-	
Suct 60 Pig 015CH File   Team   COO File							DRIVER		TONS						<del> </del>		
1   Suct   60 PBG   DISCH   FSI   TEMP   000 PG	1	PUMPAR	ONNO	AND	9			7				8					
Second   S	-	suct 60	PENG	SCH	1	TEMP	1000/									-	
A	25 m2/h			HSCH	E CHI	TER	<b>9</b>					-					Γ
AND COLOURS CASE   AND COLOURS		8	E		ĮΟ	L	STGS										Γ
NATE CASE   C.5   NATE LIED   C.5   1/2 HP		0	E		- 3		N.								F		
TYPE CENT   THE PLANS   AND   ANS   AND   AND   ANS   AND   ANS   AND   ANS   AND		52	1734001	EN.	<u>۸</u>	-	Ι.								=		
MAGEN SEAL     MAGEN   PROPESS OTHERS   AND	DRIVE EM - ES			ū		_	*				_	=			=		
Section   Sect		1-1		$ \neg $													
CA 703A \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	الا الا																
CA-703A   S	BINSUL [			E	RECT. WT. PI	UMP & C	MIVER		TONS								
Suct 6,0 PsiG Disch   Psi   Temp   0.0 of	Ą	RAFFINA	ı	JWO				2			8	20					
### Suct ### Oc Fit 50 PS1 STGS	2 mm 2		) PSIG [	ызсн			1000F								-		
## STGS   OP	3 m <sup>3</sup> /h	Ŀ	Casta	ISCH	hPe tepcm2		၁့									-	
MAT: CASE	_	٥٥	FT	71	0	_	STGS										
MAT: CASE  C.S. IMPELLER  C.S. IMPELLER  CONVE EM.—BY TUND DESEL OTHER O		Ø	£			7	APP.								H		
NECH SE AL CONTRE EN CONTRESCONTIONS OTHERS OTHERS AND ANSICONTRE CENT. PUMP & DRIVER TOTAL THIS PAGE  TOTAL		<b>c.s.</b>	HAPELL	.ER	c.S.	1	Ι.								F	<del> -</del>	Γ
TYPE CENT — IN RECIP — PROPE OTHERS   APPLIANCE   ANSI   A	M - M3 3/11/0			n 🗆			N.								F		
WECH SEAL  INDUSTRY LOCAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT AMOCO/DOG-GREAT PLAINT GASIF. PLAINT PROD. FACT  LOCATION BEVLAH, AIGRIN DAKATA  TOCATION BEVLAH, AIGRIN DAKATATA  TOCATION BEVLAH, AIGRIN DAKATATA  TOCATION BEVLAH, AIGRIN DAKATATA  TOCATION B	_					Ō						F			-	-	
TOTAL THIS PAGE  TOTAL	MECH. SEAL											F		-		-	
O/DOG-GREAT PLANK GASIF. PLAM MOD FACT LOC.MH. BY M.L. DOB NO. FUEL FROM COAL DERIVED LAWING WAGENATE LAB. COST REV. O				140	RECT. WT. P.	OMP &	JRIVER		TONS						-	-	
O/DOG-GREAT PLANK GASIF. PLAN MOD FACT LOC.M.H. BY ML JOB NO. FULLAN COAL DERIVED LAWING WAGENATE LAB. COST REV. O	TOTAL THIS PAGE											H			F	$\dagger$	
O/DOE-GREAT PLANK GASIF. PLAN PROD FACT LOC. M.H. BY M.L. DOB NO. FULAN NORTH DAKOTA FUEL FROM COAL DERIVED LAWISS WAGERATE LAB. COST REV. O	TOTAL ACCOUNT																
L DERIVED LAUID WAGENATE LAB. COST REV. O	CLIENT AMOCO	Doe	AT PL	1WK	SASIF. P	ľ	PROD. FACT	_	LOC. M.H.				7			Ĺ	130
CAN'T CAN'B	LOCATION BEC	11-AH , NO.	ETA L	2 Ka	7		WAGE BATE		LAB COST	-		DATE /3	3/3//	EST		T	₹
	1 (2 / name)	MET LYOM	2000	32	2	=				-			٥			-	7

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CASE 7 MAX PROFIT

n I				CETIMATE CUEET	- Care					THE LUI	THE LUMMUS COMPANY	PANY
	MCS			COLIMAIC	SHEEL						Bloomfield	
					OO.	QUANTITY	UNIT	MATERIAL	STD	LABOR MH	SUBC	SUBCONTRACT
	5	DESCRIPTION			REO	EA	COST	COST	†¥5	TOTAL		cost
1GA 704A 85	STRIPPER	SoT.	TOWN PUM	2	4			S Pro				
80	SUCT 20	SOISC	PSI	TEMP 3 SOOF								
3 m3/h	SUCT	NE 2 DISCH	Can and a	TEMP OC							-	
4 SP-GA	ঽ	E	50	STGS								
•	2	E	100 and 1	RPM								_
MAT: CASE	22	HAPELLER	Lo	5 H.P.								
7 DRIVE EIG - KI TU	TUMB DIESEL	OTHER [		**				_			-	
_	COP   PROP	OTHERS	I API   ANSI									
DIRECH SEAL &											-	
10 INSUL S			ERECT. WT. PUMP	MP & DRIVER		TONS						
ľ	STRIPPER	A WATER	amod 1		7			8				
12 GPM 2	S Lons	I K	Ē	TEMP 100°F				↓_				
13 m <sup>2</sup> /h	SUCT	DISCH	MBT LEM									
14 SP-GA	ð	11	50 PS	STGS								
20	ঠ	E	160 to the solutions	RPM								
16 MAT: CASE C	65	IMPELLER	< >	12 HP							-	
17 DRIVE EM - M TU	TURB   DIESEL	OTHER		×4				-				
18 TYPE CENT RE	•	1 1	API - ANSI									
19 MECH. SEAL												
20 INSUL			ERECT. WT. PUMP & DRIVER	AP & DRIVER		TONS						
706A \$5	ETRACTOR	RECK	of bring	8	7			6000				
22 GPM 15	SUCT S	PSIG DISCH	£	TEMP/OO OF								
23 m <sup>3</sup> /h	SUCT	HOSE PACE	p p	OC dM3								
2 9-GP	Qρ	F1	135	STGS								
£	٥	E	Pocm 7	APPA	_							
28 MAT: CASE	6.5	IMPELLER	CI	21/2 H.P.								
27 DRIVE EM - ST TU	TURB   DIESEL	DIESEL COTHER C		KW								
_	RECIP   PROF	O others□	JISNA   INSI									
20 MECH. SEAL ES												
30 INSUL			ERECT. WT. PUMP	WP & DRIVER		TONS						
TOTAL THIS PAGE												
TOTAL ACCOUNT												
QUENT AMOCO/DOE-GREAT PLAIN	1006-6Re	AT PLANK	K GASIF. PUM	HALL PROD FACT	1:	10C M.H.		A	ML	ON BOY	567	ACCT
LOCATION BEC	BEULAH, NORTH DA	RTH DAK	KOTA	_	+		-	DATE	DATE 12/18/	87 EST	130	8
MONECTIET FUEL FROM COAL DERIVED LAWING	WEL FROM	CONL DE	RIVED LAW	B WAGE RATE	E	LAB. COST		REV	3	,	•	
							:				A122 0482:10 REV. 3	10 REV. 3

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CASE 7 MAX PRIFIT

	8		ESTIMATE SHEET	SHEET	<b>5</b> -10					THE LUMBA	THE LUMMUS COMPANY Bloomfold	
GA- 707 A \$ 5 (GAM 65 8)												
CA- 707A\$5 (CAN 65 B)				Š	QUANTITY	UNIT	MATERIAL	ا 4-	2052	STD LABOR MH	SUBCONTRAC	Į
CA-707AFS	DESCRIPTION		•	REG	EA	COST	COST	<u> </u>	t is	TOTAL	503	
GPW 65 SH	LEAN SOLVENT	PUMP		2				-	-			Ī
m3/m	5ر	PSI	TEMP 3450F	-			07/	000	_			
	T LAST DISCH	hPa tacm2	TEMP OC									
<b>4</b> 0 ₩		20	STGS							-		
7	E	Page 1	RPM					_	-			
MAT: CASE C.S	S INPELLER	2	15 HP.						_	_		
ONVEEN- STUNG	DIESEL OTHER		**					-	-			
TYPE CENT - B RECIP	]	O API O ANSI C										
S W				_					-	_		
Ne Meur (2)		ERECT. WT. PUMP & DRIVER	AP & DRIVER	7	TONS			-	-			Γ
11GA 708A85 M	WASH WATTER	`		4			80	8	-			Π
3	5	E 35	TEMP 10 OFF					-	-			
13 mg/m Strict	T TOUSCH	CH taken2 TEN	Do JAN						-			
14 mon		105 PSI	STGS	-				-	-			
40	£	Lange I	RPM						$\vdash$			
NO MAT: CASE C S	HAPELLER	50	1/2 H.P.						-			
17 ORIVE EM - ED TURE	DIESEL OTHER [		kW									
ام	REC.P   PROP IST OTHERS	□ API □ ANSI □	]									
MECH. SEAL												
Ć		ERECT. WT. PUMP & DRIVER	P & DRIVER		TONS							
n Ca 709415 Re	RECOVERY COLM	dund anno		7			9	700				
25	T - S PSIG DISCH	ž.	TEMP /00°F	-					_			
	1	her.	JO WHELL	-								
2 SP.CH		80	STGS									
			RPM							_		
	S INFELLER	I	21/2 M.P.						_	_		
27 DRIVE EM - S TURB	DIESEL OTHER		MI	_								
	NECIP   PROP   OTHERS	O API O ANSI		-				H	-			
20 MECH. SEAL [3]				-					-	_		
39 INSUL		ERECT. WT. PUMP	P & DRIVER		TONS			-				
TOTAL THIS PAGE								F	$\vdash$	$\vdash$		
TOTAL ACCOUNT				H					-			
CLIENT AMOCO/DOE-GREAT PLAINS GASIF. PLAIN	E-GREAT PLAIN	WGASIF. PU	PROD. FACT	1	LOC. M.H.	_		N 111		2	(12)3	ACCT
MOCATION BEULAH, MORTH DAKOTA	H NORTH DA	KOTA EZIVED I Juli		<u></u>	LAB. COST	_		DATE /7/14/8	18/87	EST	200	₹5
1201 (2 / 10 mm)	かったい からくし	באונט האמוי	= 3			4					1;	]

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CASE 7 MAX PRUFIT

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	200											1
	8	DESCRIPTION		<u>t</u>	g	QUANTITY	LINO	MATERIAL	STO	LABORI MH	SUBCONTRAC	TA AC
					REG	EA	COST	cost	CNIT	TOTAL	COST	
GA-710A\$S WATER		STZIPPER B	BTMC PUM,	Ju	2			8				
2 GPM 2	_	PSIG DISCH	152	TEMP 25/ 04	_							
W-W		MACH DISCH	hPe 2	TEMP OC								l
SP.GA	2	E		STGS	-							
	0	E	kocm2	RPM	-			_				
MAT: CASE	65	IMPELLER	20	-AH 2/1								
DRIVE EN - ST TU	TURB   DIESEL	O OTHER		M.W	-							1
احا		ł	API ANSI		-							
i		ı	(		-							
10 INSULES			ERECT. WT. PUMP	MAP & DRIVER	-	TONS						
11 GA 711 A \$5	EJECTOR	COND	アンチアア		7			8000				
	sucr - 5	1	ž	TEMP 100 OF								
13 m3h	suct	PEZ DISCH	horms horms	TENP OC								
14 SP.GR	ΔÞ	11	50	STGS	-							
	2	E	Specific Control	2 RPM	<u> </u>							
MAT: CASE	57	IMPELLER	52	1/2 HP	-							
17 DRIVE EM - 12 TU	TURE DIESEL	□ OTHER □		W.W.	<b></b> -							
18 TYPE CENT RE	RECIP   PROP 12	OTHERS [	API C ANSI									
7				•	1							
20 INSUL			ERECT. WT. PUMP	MP & DRIVER		TONS		7				
S 212 vo	SOLVENT	TRANSFE	ER PUMP					000				
22 GPM 50	SUCT O		Ē	TEMP 100 %								
سواي	SUCT	HOSIO CHO	I hara TEMP	EMP OC	_							
SP-GA	Δr	FT	00/	STGS								
	Ø	E	ribe ribe	MAB RPM	_							
MAT: CASE	52	IMPELLER	77	9 H.P.								
DRIVE EN - EG TU	TURE   DIESEL	OTHER []		tw								
TYPE CENT - 🖾 RI	RECIP   PROP	☐ OTHERS□	API ANSI									
NECH. SEAL 🔯					_							
D INSUL			ERECT. WT. PUMP	WP & DRIVER	-	TONS						
TOTAL THIS PAGE					-							
TOTAL ACCOUNT												
20	300/	SAT PLAIN	K GASIF. PUM	PROD FACT	_	LOC. M.H.		<b>∆</b>	M	JOB NO.	, 1255	ACCT
MONEY TET EUF		STA DAY	FROM COM DEPIVED I MILLER	WAGE RATE		LAB. COST	-	DATE	18/2/21		1	5
			K	7			1		I			I

700 ARLA

CASE 7 MAX PRAFIT

E Summus	MUS			ESTIMATE SHEET	SHEE	<b>-</b>				THE LUMM	THE LUMMUS COMPANY
	2				8	OUANTITY	11701	MATERIAL	100	STO LABOR MAI	
	5	DESCRIPTION			REO	EA	COST	COST		TOTAL	SUBCONTRACT
213	WET SOLVENT	<b>L</b>	Dung					1			-  -
C 2 Mg 2	SUC	2	Z.	TEMP 1000F						_	
3 mJA	SUCT .	W. ONSCH	CH FEET	TEN							
# SP.CA	ð	E	26	STGS						-	
	Ø	E	Sept.					+		+	+
BMAT: CASE	6.5	IMPELLER	To	5 HP				-		-	
7 DMVE EM - 18 TU	TUNG   DMESEL	OTHER		**				-		-	-
B TYPE CENT - ES A	-		ISMY   I AMS					+		1	
7	•	1						-		1	+
10 INDIA			ERECT. WT. P	ERECT WT. PUMP & DRIVER		TONS		-		+	+
11 CA 714 AEB	SOLVEN	5011	guing &	Meeting Street	2			9	1	+	
12 cm 50	BUCT	1	ř	TEMP 3500F				3		+	+
	-	Ois	The state of	4				-		1	+
14 W-GA	40	11	20	STGS						-	+
	2	E	180 J	APP.				-			+
16 MAT. CASE	CI	IMPELLEP	75	2//2				-		-	+
17 BRIVE EN - SE TU	TUMB   DIESEL	] OTHER		A.				-			
10 TYPE CENT - IN RE	RECIP   PROF	OTHERS [	API ANSI								
TO MECH SEAL E	VERTICAL	AC SUR	ind di							-	
28 INSIA.	- [		ERECT. WT. PUMP &	MAP & DRIVER		TONS				-	
21 GA 715AFS	centy To	TOWER F	EED PUINT	9.	4			OF THE PROPERTY OF			
22 CP 10		O PSIG DISCH	38.	TEMP 100 OF	-			_		-	-
	SUCT	Party DISCH	CH Lycm2 TEM	1 -				-		-	
<b>8</b> .68	Δ۶	ы	283	\$1GS	-						1
*	3	E	Later A	L2 RPM							
MAT: CASE	2.5	IMPELLER	50 1	3 HP							
•	TURS   DIESEL	DIESEL OTHER		A.	<u> </u>						
TYPE CENT - N	RECIP   PROF	OTHERS	API   ANSI								
B MECH. SEAL S					$\mid$						
30 INSUL []			ERECT. WT. PUMP & DRIVER	MP & DRIVER	+	TONS	1				
TOTAL THIS PAGE				=	$\dagger$		1				+
TOTAL ACCOUNT					-		1				
QUENT AMOCO/DOB-GREAT PLAINS GASIF.	(DoG-6RG	T PUAL	N SASIF. PL	Pular Book sacr		1		٤		٤	1,000
LOCATION BEO	"LAH , NOR	77 17	KOTA	_		LOC. W.H.			Í	E 5	557
MONECTIET FUEL FROM COAL DERIVED LAUIS	VEC FROM	CONL D	ERIVED LAW	MAGE HATE	77.	LAB. COST		REC	2	7	5
											A122 0482 10 BEV 1
											7 (mat. 10 mm a

A122 0482-10 REV. 3

	-										
S S LUMMUS	MUS			ESTIMATE SHEET	SHEET	L				THE LUMMU	THE LUMMUS COMPANY Bloomfield
	]				00	QUANTITY	UNIT	MATERIAL		STD LABOR MH	SUBCONTRACT
		DESCRIPTION			REO	EA	COST	COST	5	TOTAL	cost
1 GA 716 A#S	BENEENE	COLN BTHS	MY PUMP		7			6			
2 GPM /5	1 V)	PSIG DISCH		TEMP 3000F	-						
3(m)A	SUCT	HOSIO CHI	tgrcm2 TE	TEMP OC							
S-GA	2	Ŀ	40 85	STGS							
9	QΦ	E	Per	RPM							
6 MAT CASE	25	IMPELLER	CI	H H							
7 DRIVE EM - A TL	TUMB   DIESEL	] OTHER		KA	_						
۱			JISNA   194								
ı		l l									
10 INSUL S			ERECT WT PUMP	IP & DRIVER		TONS					
11 GA 717A \$5	BENZENE	COLN RE	FYLUX PUM	م ر ر	7			8	1		
12 GPM 50	SUCT S	1.	25	TEMP 1400F							
13 m <sup>3</sup> /h	SUCT	HOSIQ CH	aprema TE	TEMP °C							
14 SP.GR	ΔP	FŢ	BS PSI	STGS							
18	40	E	hPe l	Men							
16 MAT. CASE	6.5	IMPELLER	$C\mathcal{I}$	3 HP							
17 DRIVE EM - TU	TURB   DIESEL	] отнея □		KW							
_	RECIP   PROP	OTHERS [	API - ANSI								
19 MECH. SEAL ES											
20 INSUL 🗌			ERECT, WT. PUMP & DRIVER	P & DRIVER		TONS					
21 GA 718 A 15	36NZ6NE	N N700	MATER P	DWW	2			Soo			
72 GPM //3	SUCT /O		PSI TE	TEMP 140 OF							
23 m <sup>3</sup> /h	suct	HOSIQ CH	horem2 TE	TEMP OC							
2 SP.CR	٥٥	Ħ	45 PSI	STGS							
12	ð	E	korm²	HPM							
28 MAT. CASE	52	IMPELLER	57	1/2 H.P.							
TORIVE EM - EST TU	TURE   DIESEL	] отнея 🗌		MY							
28 TYPE CENT - C R	RECIP   PROP [X]	OTHERS [	OISNY   IN								
29 MECH. SEAL					-				_		
30 INSUL			ERECT. WT. PUMP & DRIVER	P & DRIVER		TONS					
TOTAL THIS PAGE								-	_		
TOTAL ACCOUNT											
CLIENT AMOCO	1.5.1	AT PLAINS	ALLINS GASIF. PULL	M PROD. FACT	1.	LOC. M.H.	_	AB	711	C J S ON BOT	120V /63-
LOCATION BEULAH		L.Y	274		$\downarrow$		+	DATE	TE 17/8/3	) LEST /	21/1 GA
MOJECT JET F	N	-	DERIVED LOWIDS WAGE HATE	3 WAGE RAT	E	LAB. COST		REV			

4	70	Dearl		700A	(			·			
				ESTIMATE SHEET	SHEET				1	THE LUMMU	THE LUMMUS COMPANY Bloomfield
	MOS				Ş	QUANTITY	UNIT	MATERIAL	STO	STD LABOR MH	SUBCONTRACT
		DESCRIPTION		<del></del>	REO	EA	COST	COST	<b>†</b>	TOTAL	553
164. 7.9 A 4C	BENTENE	WE PRADOC	T pump		7			Bec		+	+
	SUCT	N.	PSI TE	00/						-	-
E CE	SUCT	HOSCH PROBLE	Agem2 TEMP		1			+	1		
	0	FT	85 PSI	\$765							
	ø	E	Pocms	MAR	1			+			-
MAT CASE	50	IMPELLER	cI	SHP	1						-
8	1	DIESEL OTHER		N,				1	1	+	-
l	חו	PROP OTHERS	API [] ANSI								
1				ļ		TONG					-
			ERECT WT PUMP	AP & DRIVER		IONS		10	+		
10 4 2 4 4 5 M	The KNE	VE COUN RIMS	ars pump		4			0000	1	+	-
2 1007/	Suct	D PSIG DE	ž	TEMP 330 OF				-	-		 
200	SI ICT	PE 2 DISCH	Pocmy TE	TEMP OC							+
E - E - C	2		30 PSI	STGS							+
2	•	•	NPs Referra	HPM					+	1	
500 200		IMPELLER	6.5	1/2 41							+
02	THOR	DIESE! OTHER		Wi				1	+	1	+
1_		OTHE	API - ANSI	)				1	+		
		.1						+	+	-	-
NSUL BO			ERECT WT PUN	PUMP & DRIVER		TONS		_	-		1
21 CA 77.4 35	TOLVENE	COLN R	EFLUX PUBL	010	4			0			-
20 CP 20 20	SUCT	١.	152	TEMP 200 OF					+		-
ļ	Suct	HOSIO PAGE	404 Agreem	TEMP OC				1		-	-
200	0	11	75	STGS				+	+	+	
2 8	ð	E	kg/cm <sup>2</sup>				=		+	1	+
28 MAT CASE	6.5	IMPELLER	CI	2 12			1	+	+	-	-
Ø	I	DIESEL OTHER		r.w				+	+		
×	$I_{-}$	PROF   OTHERS	API ANSI					+	+	-	
,							 	+	+	+	+
30 INSUL K			ERECT WT PU	PUMP & DRIVER		TONS	4	+	+	+	+
TOTAL THIS PAGE							+	+	+	+	+
TOTAL ACCOUNT						-	<u> </u>	4	7		JOV J
CLIENT ALLOCO/DEE-6REAT	-3×1/0	77	GASIF.	PLAIN PROD FACT		LOC. M.H.		ه ۵	BY /////	EST NO.	1255
LOCATION BE	BEULAH	7	24 CCTA	MAGE RATE	N N	LAB. COST	ST	REV		- 78	
PROJECT JET FUEL	~	FKONI COME	CINCO COMIS	=	}		1				A122 0482.10 REV.

Columbia Company   Columbia Columbia Company   Columbia Columbia Company   Columbia Colum												
Suct		MUS			ESTIMAT	ESHEE	<b>-</b>				THE LUMMU	IS COMPANY
						000	ANTITY	LINIT	MATERIAL	STI	LABOR MH	Suprovine A
		8	ESCRIPTION			REG	EA	COST	COST	ŧ₹5	TOTAL	COST
SUCT	A227.A0		VE PROP	1	du	7			288	⊨		F
Sucr	GPM 7		PSIG DISCH	1S.d	0/				) V	-		
Ab	m <sup>3</sup> /w	SUCT	horem? DISCH	Apr. m2								
Ab	SP.GR	ΔP	FT	IV	1					_		
Stock   Stoc		ΔP	E	PO/OR								
RECIP   DIESE   OTHER   DANSI   DANS	MAT CASE	57	IMPELLER	N	-							
TO LUE LUE   PROP   OTHERS   APP   AND	DRIVE EM - 12 TI	1			**							
Suct	_[		OTHERS []	l I	[]							
TO Lu EVE PRODuct Pump a dinuera   Tons	i 1			l								
Compared	ואפחר []			5	UMP & DRIVER		TONS		-			
Suct o   Fist   Discribing   Fist   Discribing   Fist   Discribing   Fist   Discribing   Discribing   Fist   Discribing	SF 4527 AD	7010EN	•	ļ	21	2						
SUCT	52 Mas	SUCT O	I K	PSI	EMP /0				_			
Applied   App	m³/m	SUCT	Barens DISCH	torm?		7=						
MAT. CASE    OPEN CENT. SET   OPEN CLT   OTHER   OTHE	SP.GR	ΔP	FT	h								
DRIVE EM -		40	Ε	t dict								
NECH SEAL     NECH	MAT. CASE	2.5	IMPELLEM	H								
NECH -     NECH       NECH       NECH       NECH       NECH       NECH       NECH         NECH	DRIVE EM - ST.		_ 1		kW							
SECT   SECT WIT PUMP & DRIVER   TONS   TEMP   Correct Not pump & DRIVER   TONS   TEMP   Correct Not pump & DRIVER   TEMP   Correct Not pump & DRIVER   TEMP   Correct Not pump & DRIVER   Correct Not pump & DRIVER   TOTAL THIS PAGE   TOTAL THIS	- 1	•	OTHERS []									
GA-  GA-  GA-  GA-  GA-  GA-  GA-  GA-	MECH. SEAL M											
GPM SUCT   PSIG   DISCH   PSI   TEMP   OF	INSUL []		-	FRECT WT PU	IMP & DRIVER		TONS					
SUCT   PSIC   DISCH   PSI   TEMP   OF	GA.											
SP.GR   SUCT   No.	GPM	SUCT	PSIG DISCH	Ē								
∆P   FT   PSI   STGS	m <sup>3</sup> /h	SUCT	Borem 2 DISCH	Agren 7								
OP	SP.GR	ΔP	FT	ž								
TUNB □ DIESEL □ OTHERS □ ANS I□ ANS I□  RECIP □ PROP □ OTHERS □ ANS I□ ANS I□  SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   BY     LOC. M.H.    SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z   EST NO 557/Z    SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z    SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z    SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z    SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z    SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z    SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z    SE CUL CHILL LIOSTIN CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z    SE CUL CHILL LIOSTIN CHILL CHILL AND IN STATE   LOC. M.H.   DATE   Z/R/X/Z    SE CUL CHILL LIOSTIN CHILL CH		Δ۴	E	n year					-			
RECIP   DIESEL   OTHERS   ANS I   A	MAT CASE		IMPELLER		ē I							-
NECH SEAL ☐  NECH SEAL ☐  NECH SEAL ☐  NECH SEAL ☐  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT #///OCO/DOE-GREAT DAMS GAS/F. PLAY PROD. FACT LOC. M.H. BY MLL AOB NO 557/  LOCATION & CULT FUEL FOR F. PLAY WAGE NATE LAB COST BEY					kw				-			
MECH SEAL []  INSUL []  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT #11/0C.C./DCE-GREAT PLAINS GAS/F. PLAIN PROD. FACT  LOCATION & EULAH / JUOXTH CALLAND MAGE RATE  TOTAL ACCOUNT  CLIENT #11/0C.C./DCE-GREAT PLAINS GAS/F. PLAIN PROD. FACT  LOCATION & EULAH / JUOXTH CALLAND MAGE RATE  THAN COST  RADIE / PLAINS / PL	TYPE CENT -		OTHERS									
TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT #1/10 Co / Doce - G/7CE/T   Doce / D	MECH. SEAL											
OLDGE-GREAT PLAINS GASIF. PLAIN PROD. FACT LOC. M.H. BY 11/4 JOB NO 5571	INSUL []		E	RECT. WT. PU	IMP & DRIVER		TONS		-			
COLDEE-GREAT PLAINS GASIF. PLAIN PRODERCT LOC. M.H. BY 11/L NOB NO 5571  FUEL FORM ALL SHOWN ALL SHOWN AND WASERATE LAB COST BEY	TOTAL THIS PAGE											
HAS GASTE. PLAN PRIOD FACT LOC. M.H. BY MILL JOB NO 5571	TOTAL ACCOUNT											
FUEL FORT CALL CALL CALL CALL CALL CALL CALL CAL	CLIENT AM/OCC	DOE-GRE		GASIF. PL	Į	CT	LOC. M.H.		<b>∆</b> 6	3:	JOB NO	
	PROJECT THE A	20 F( F	<i>3</i>	/A		16	I AR COS		IVA S	27		Τ

DES	ign con	IPUTA	TIONS	-OR		- 100 C	<u> </u>	८€	·	
JOB_	55	7/	AC	ст	·····				<del></del> -	
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		محرى	PAZITI	-	6	5 (	FPM	O	F SOLVENT	
			P = 3							
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										5,000
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										5,000
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			, .		• 7	-,,,,,				
										15,000
										THE LUMMUS COMPANY
a	14/8/87	1								Bloomfield N. J.
REV.	DATE	MADE	CHKD.	APPR.	Record	REV.	ISE	UE	DWG. NO.	
										A106 03 0776-1 REV.1

## 6.0 EQUIPMENT DATA AND ESTIMATE SHEETS

## 6.3 Phenol Stream

6.3.1 AREA 800

6.3.2 AREA 850

6.3.3 AREA 900

## **AREA 800**

LIENT: DOE

PROJECT: 5571

LOCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

21-Mar-89 08:46 AM

**EQUIPMENT** 

# PCS. \$ EQUIP.

**\$ COMM** 

\$ COMM

<u>HEATERS</u>
TOWERS
INTERNALS
REACTORS
<b>EXCHANGERS</b>
VESSELS
TANKS
<b>FILTERS</b>
PUMPS
COMPRESSORS
PACKAGE UNITS

TOTAL

<del></del>			
5	\$776	100	\$776
	\$143	0\$	\$0
		90	\$0
14	\$332	100	\$332
9	\$73	120	\$88
3	\$53	80%	\$42
			\$0
52	\$440	100\$	\$440
7	\$165	70%	\$115
90	\$1,982	!	\$1,794

## SUMMARY

**EQUIPMENT** 

\$1,982

COMMODITIES

\$1,794

LABOR

\$1,274 (10% EQUIP,60% COMM)

INDIRECTS

\$1,274 (100% LABOR)

**ENGINEERING** 

\$3,600 (800/PC X \$50)

SUBTOTAL

\$9,924

CONTINGENCY

\$1,985 (20%)

TOTAL

\$11,909

		WEIGHT MATE.		\$/LB	₩.
	TASH COLUMN	72000	72000 CS CLAD	\$3.00	\$216,000
	RYER	0006	CS CLAD	\$4.50	\$40,500
DA-803 P	MENOL COLUMN	123000	CS CLAD	\$3.00	\$369,000
	TRIPPING COLUMN	33000	33000 CS CLAD	\$3.50	\$115,500
	LIGHT ENDS COLUMN	7000	CS CLAD	\$5.00	\$35,000
				TOTAL	\$776,000
		FT2	MATL.		8
DB-801 F	TASH COLUMN	2200	CS/SS VA	\$18.00	\$39,600
DB-802 D	RYER	125		\$20.00	\$2,500
DB-803 F	HENOL COLUMN	4500		\$18.00	\$81,000
DB-804 S	TRIPPING COLUMN	1000		\$18.00	\$18,000
DB-805 I	LIGHT ENDS COLUMN	110		\$20.00	\$2,200
DB-805 I	LIGHT ENDS COLUMN	110		\$	

\$143,300

TOTAL

		FT2	FT2 MATL.	\$/FT2 \$	404
A-801	A-801 FLASH COL COND.	1195	cs/cs		
A-802	FLASH COL REBOIL	4455	cs/316	\$26.25	\$116,944
A-803	DEPHENOLTIZED CRESYLIC	140	316/316		\$18,900
	ACID COOLER				
ZA-804	PLASH COL TRIM COOL.	390	390 CS/CS	\$23.00	\$8,970
A-805		530	cs/cs	\$19.00	\$10,070
34-806	PHENOL COL REBOIL	1480	CS/316	\$35.00	\$51,800
A-807	PHENOL COL COND	1730	cs/cs	\$14.00	\$24,220
2A-808	LT. ENDS COL COND	345	cs/cs	\$23.00	\$7,935
₩-109	LT. KNDS COL REBOIL	150	150 CS/316	\$122.50	\$18,375
<b>24−6</b> 10	STRIPPING COL COND	1050	cs/cs	\$16.00	\$16,800
IA-811	STRIPPING COL REBOIL	105	316/316	\$122.50	\$12,863
A-812	PHENOL COOLER	06	316/316	\$122.50	\$11,025
IA-813	TAR COOLER	175	cs/cs	\$40.00	\$7,000
A-614	STRIPPING COL SIDE REBOIL	450	cs/cs	\$20.00	000'6\$

\$331,826

TOTAL

		WEIGHT MATE.	\$/I.B \$	
FA-801	FLASH COL REFLUX DRUM	2000 CS	\$3.50	\$7,000
FA-802	DRYER COL	3000 CS	\$2.75	\$8,250
PA-803	PHENOL COL REFLUX DRUM	4000 CS	\$2.25	\$9,000
PA-804	STRIPPING COL REPLUX DRUM	1000 CS	\$4.00	\$4,000
PA-805	LT. ENDS COL REFLUX DRUM	1000 CS	\$4.00	\$4,000
PA-806	CRUDE PHENOL SURGE DRUM	16000 CS	\$1.50	\$24,000
PA-807	CRYSYLIC ACID DRUM	1000 CS	\$4.00	\$4,000
PA-808	PHENOL DRAWOFF DRUM	1000 CS	\$4.00	\$4,000
FA-809	LT. ENDS DRUM	4000 CS	\$2.25	000'65
			TOTAL	\$73,250
		BARRELS MATL.	\$/BBL \$	
FB-801		SO 06	\$90.00	\$8,100
FB-802		576 CS	\$40.00	\$23,040
FB-803	PHENOL DAY TANK	440 CS	\$50.00	\$22,000

	Ħ	MATL.	\$ dH/\$	
GA-801, CRUDE PHENOL PUMP	<10hp	cs	 	\$15,000
GA-802, FLASH COL REFLUX	<10hp	cs	1 1 1 1	\$15,000
GA-803, PLASH COL BITM.	<10hp	cs	1 1 1	\$15,000
GA-804, ACID TAR	<10hp	cs	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	\$15,000
_	<10hp	cs	1 1 1 1	\$15,000
GA-806, LT. ENDS COL FEED	<10hp	cs	1 1 1	\$15,000
SU	<10hp	cs	1 1 1 1 1	\$15,000
•	<10hp	cs	1 1 1 1	\$15,000
_	<10hp	cs	!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	\$15,000
GA-819, LT. KING COL BITHS	<10hp	cs	!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	\$15,000
	<10hp	cs	!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	\$15,000
GA-812, DRYER REFLUX	<10hp	cs	1 1 1 1 1 1	\$15,000
GA-813, PHENOL COL REFLUX	20HP	cs	1 1 1 1 1	\$20,000
GA-814, PHENOL DRANOFF	<10hp	cs	1 1 1 1 1	\$15,000
GA-815, PHENOL COL BITH	<10hp	cs	[ t t t t t t t t t t t t t t t t t t t	\$15,000
GA-816, STRIPPING COL REFLUX	<10hp	cs	t t !	\$15,000
GA-817, STRIPPING COL EXTRACT	<10hp	cs	1 1 5 1	\$15,000
GA-818, STRIPPING COL BITH	<10hp	cs	!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	\$15,000
GA-819, PHENOL CHARGE	<10hp	cs	 	\$15,000
GA-820, DRYER COL BITHS	<10hp	cs	! ! ! !	\$15,000
GA-821. WASH WATER	<10hp	CARP 20	 	\$30,000
GA-822, TAR CIRC.	<10hp	CARP 20	!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	\$30,000
GA-823, WASH WATER CIRC	<10hp	CARP 20	!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	\$30,000
GA-824, TAR PUMP	<10hp	cs	!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	\$15,000
GA-825, TAR STORNGE	<10hp	CS	!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	\$15,000
GA-826, LT. ENDS COL WATER FURP	<10hp	cs		\$15,000

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DOE JET FUEL

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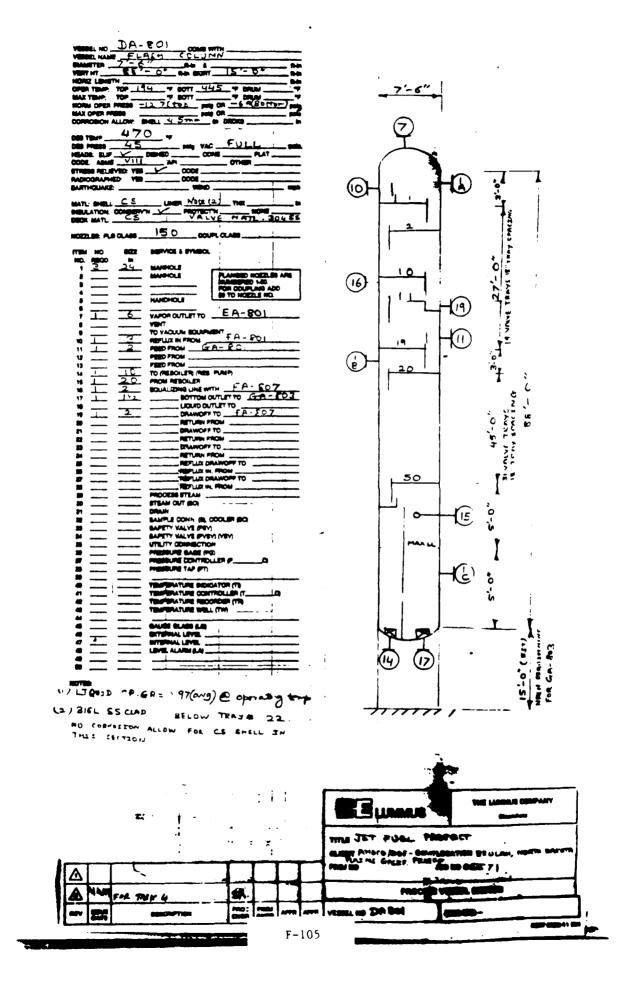
1ST STG WASH FILTER	2ND STG WASH FILTER	1ST STG WASH MIXER	2ND STG WASH MIXER	SULFURIC ACID MIXER	THIN FILM EVAP	VACUUM SYSTEM
FD-801	PD-802	GD-801	GD-802	GD-803	ED-801	PA-801

\$5,000 \$5,000 \$5,000 \$5,000 \$5,000 \$50,000

\$165,000

TOTAL

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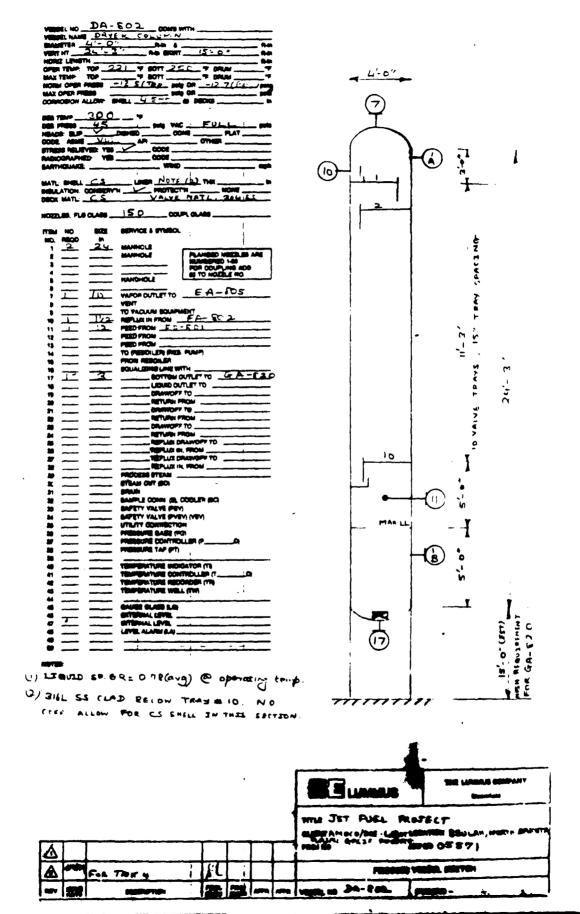
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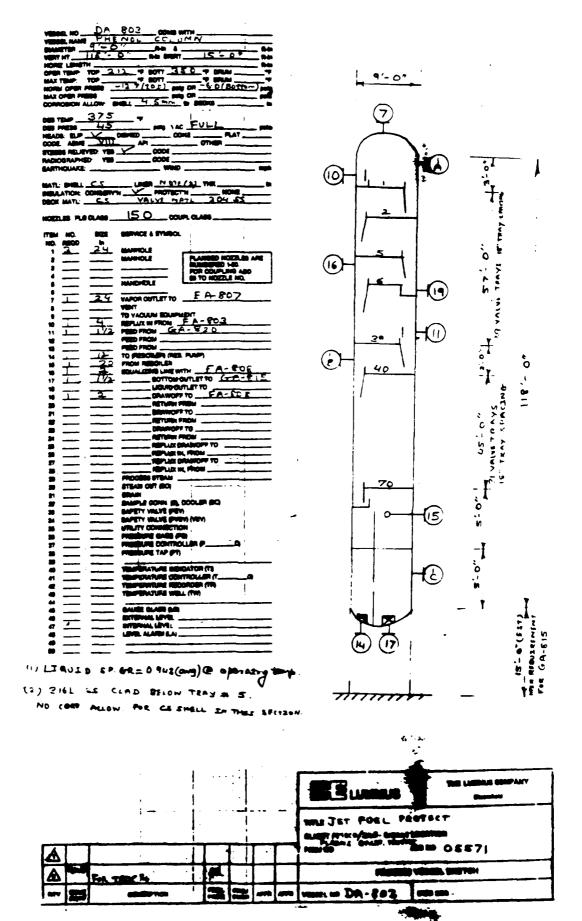
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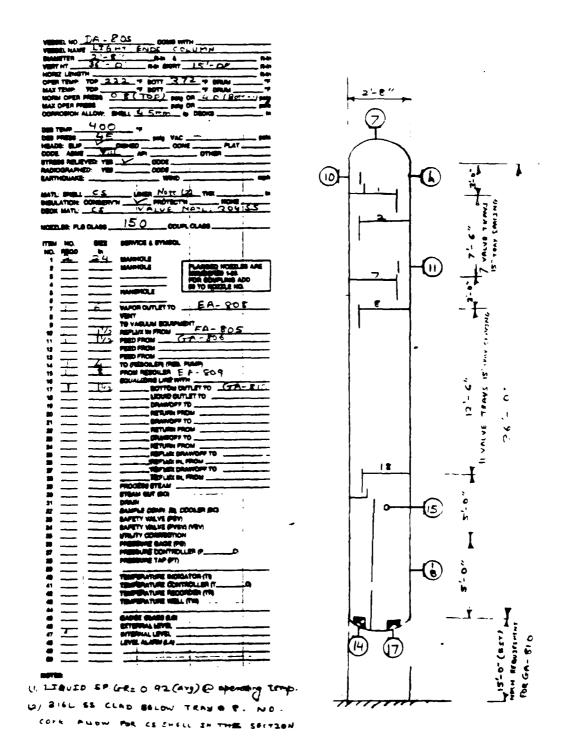
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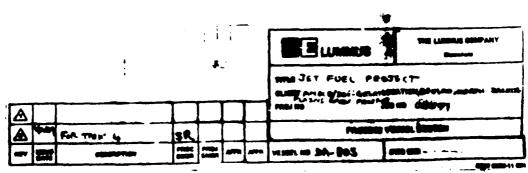
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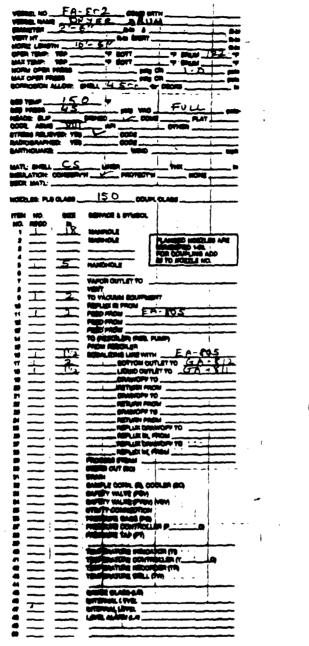
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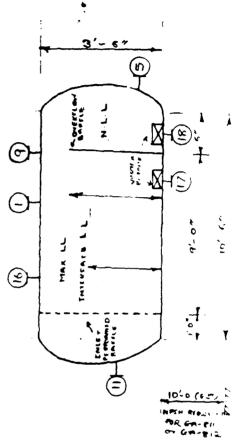
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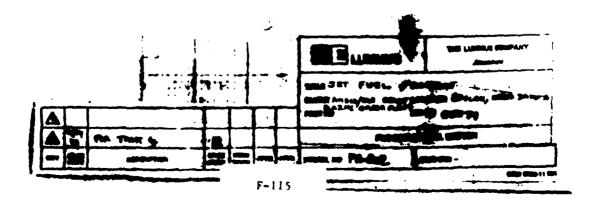
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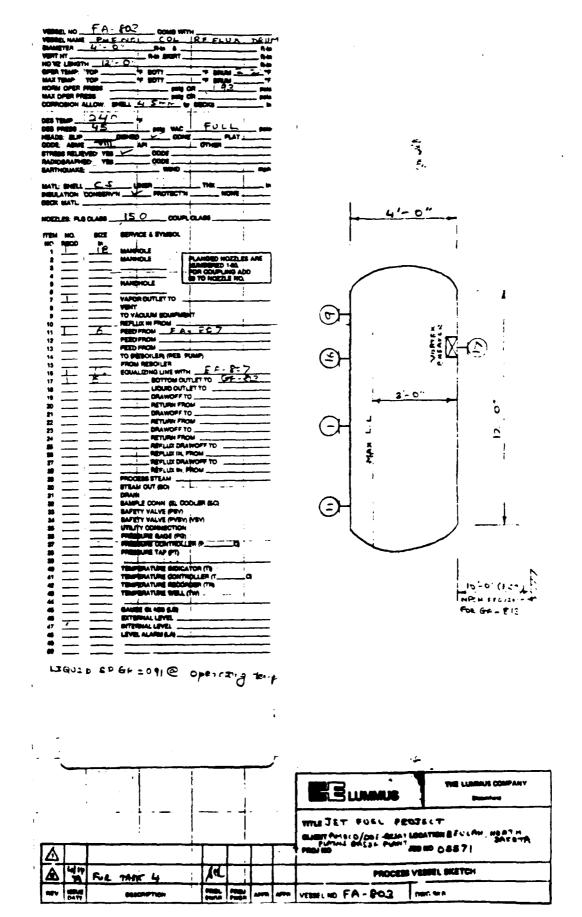
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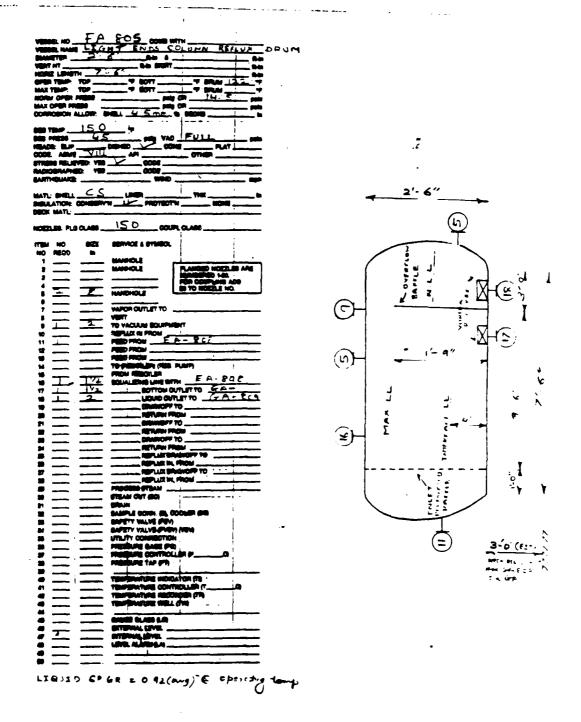


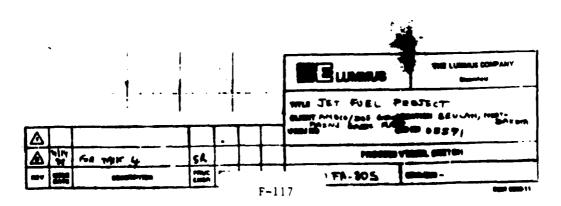


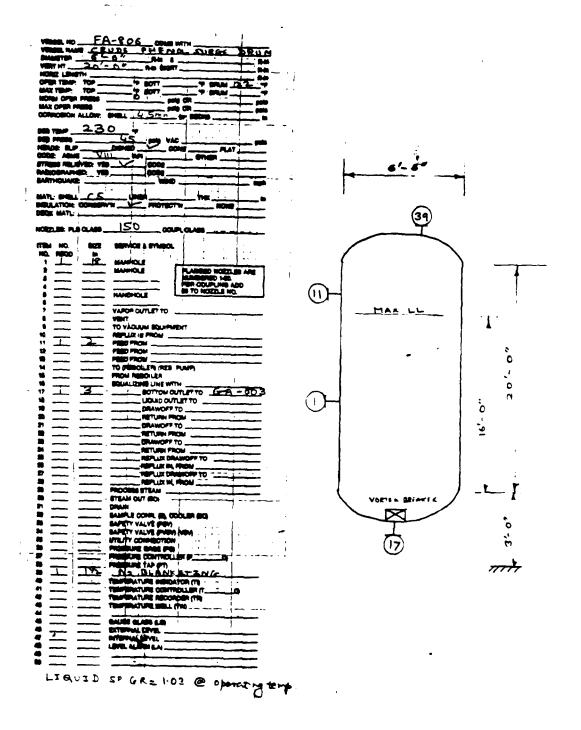
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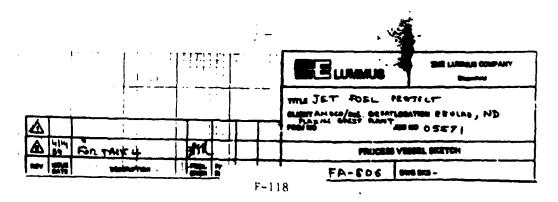


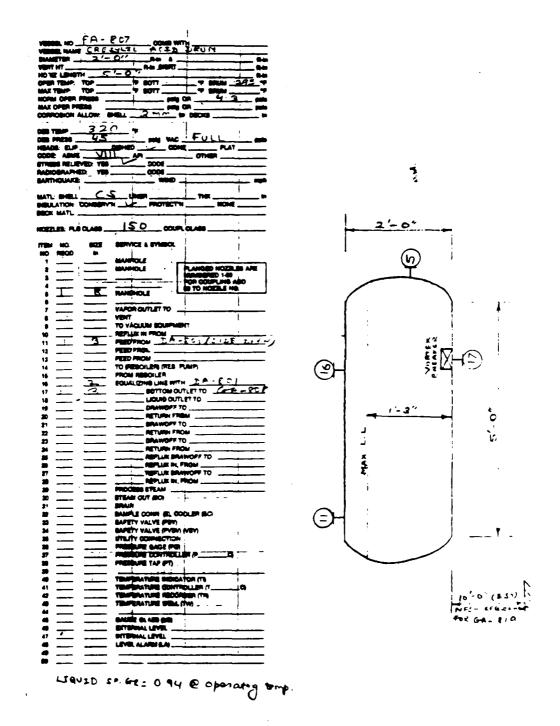












THE LIMITURE TO THE LIMITURE COMPANY

WITH JST FUEL PROJECT

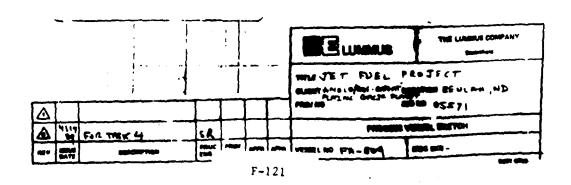
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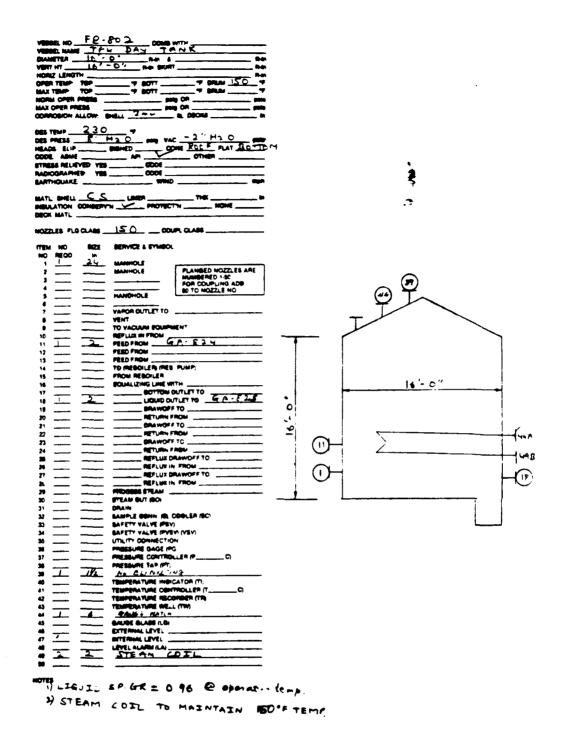
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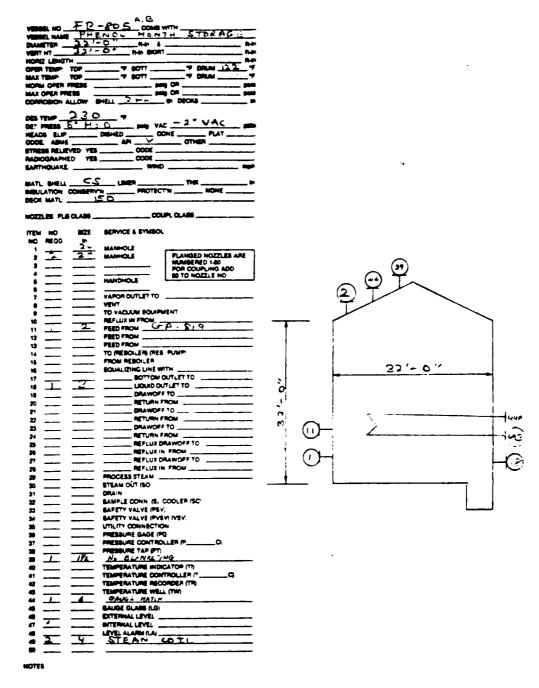
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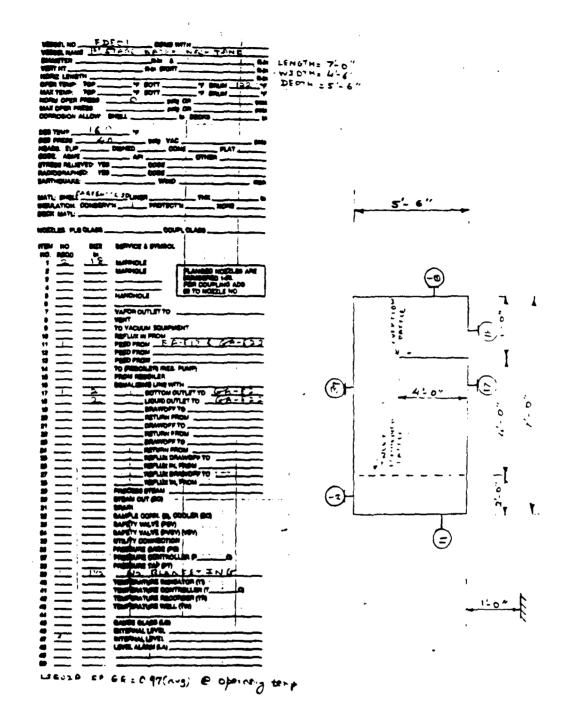
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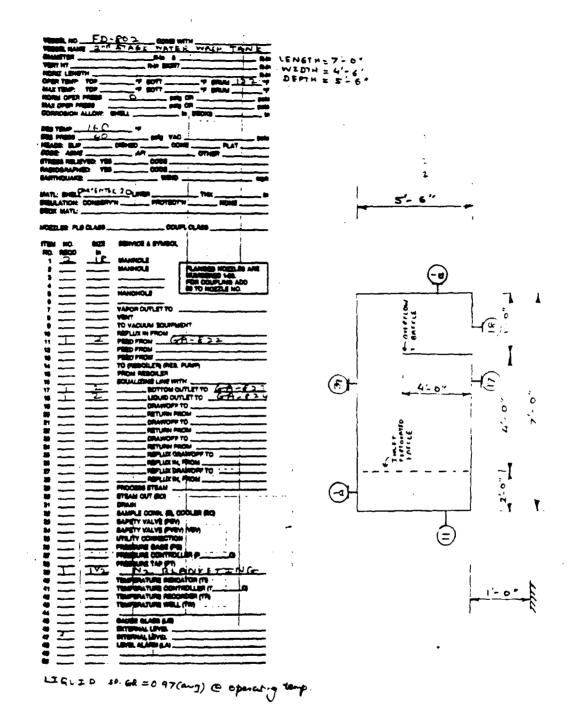
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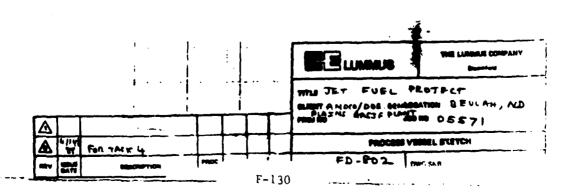
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STRIPPING COLUMN SECTION (PROPRIETARY DESIGN)

DA-804 STRIPPING COLUMN

COLUMN DIAMETER (ID) : 4'-6"

COLUMN HEIGHT (T-T) 100 -0"

60 VALUE TRAYS

SHELL MATL: CS LINER: 316L SS CLAD

VALVE MATL: 304 SS

FA-804 STRIPPING COL REFLUX DRUM

CAPACITY 135 It3

MATL : CS CORP ALLOW: 4. Strin

EA-810 STRIPPING COL CONDENSER

SUPFACE AREA: 1050 1+2

CHELL METL: CS CORR PHOW 45mm

TUCE MATE : CE

3mm

EF- 814 : STPIPHING COL. SIDE REGOLLER

( KETTLE TUPE)

SURFACE AREA : 450 12

CHELL MATL. CS CORR ALLOW 45mm TUPE MATL: CS . 3mm

ł									- 1	·
										THE LUMMUS COMPANY
O	4114 64	SR								Bloomfield,N J.
REV	DATE	MADE	CHKD.	APPR.	Reserve	REV.	188	IUE	DWG. NO.	

A106 03 0776-1 REV.1

# EA-811; STRIPPING COLUMN REPOILER

SURFACE AREA = 105 +12

SHELL MATE : 316L 22 TUGE MATE : 316L 25

GR-816 A,5 : STRIPPING COL. REFLUX PUMP 20 GPM X 70 PS I

GA-817 A, S. STREPPING COL. ORGANIC EXTRACTIONS
5 GEM X 20 FOL

GA-RIB A, C. STRIPPING COL PINS PUMP 9 JENX 40 PSI

			· •						• -	 <u>-</u>
0	4/14/24	SR-								 THE LUMMUS COMPANY Bloomfield, N. J.
REV.	DATE	MADE	CHKD.	APPR.	Record	REV.	181	WE	DWG. NO.	

A106 03 0776-1 REV.1

DESIGN COMPUTATIONS FOR ED-801 (Thin Film Every orector)

JOB JET FUEL PROF ACCT. 05571

ED-801 (THIN FILM EVAPORATOR DUTY = 1.68 × 106 Btu/hr SURFACE AREA . 180 ft2 MP STEAM REG : 1900 lb/hr. MATL: 316L SS or CS WITH 316L SS CLAD HE LUMMUS COMPANY Moomfield, N. J.

A106 03 0776-1 REV.1

DWG. NO.

4/14/19 SR



THE LUMMUS COMPANY

Always refer to this number

Div. Job PO/Req. Sup

DATA SHEET-LIGUID RING VACUUM PUMP

1	APPLICABLE TO PROPOSAL PURC			ITEM NO	GE80	MACS	
2	FOR AMCIO/LUI - JET FUF	r bise	7617	UNIT			
3	SITE			DRIVER			
4	SERVICE VACUUM PUMP FO	R 800	ARFA	NO REO	UIRED		
5	MANUFACTURER	MODEL			SERIAL NO	,	
6	NOTE O INDICATES INFORMATION TO BE	COMPLETED	BY PURCHAS	ER [	BY MANUF	ACTURER	
7							
8	0	PERATING	CONDITION	IS			
9	(ALL DATA ON PER UNIT BASIS)				OTHER CO	NOITIONS	
10		NORMAL	RATED	Α	8	С	RUNIN
11 ]	GAS HANDLED (Also See Page 3 of 3)				<b>↓</b>		
12	MMSCFD/SCFM (14.7 psia & 60°F dry)	·			<del></del>		
13	WEIGHT FLOW (lb/min) - (Wet) - (Dry)	L	32	<u></u>	<u> </u>		
14	INLET CONDITIONS:						
15	PRESSURE (psia) *		2:37		<b>↓</b>		
16	TEMPERATURE (OF)		160		<b></b>		
17	RELATIVE HUMIDITY (%)				<b>↓</b>	<u> </u>	ļ
18	MOLECULAR WEIGHT (MI		<u> </u>		<del> </del>		
19	The Appendix Programme (CP/CV)		1.39		<b>↓</b>	<b></b>	
20	COMPRESSIBILITY (Z1) OR (Zavg)		1.0		<del> </del>	<b></b>	
21	INLET VOLUME, (cfm-WET)*	<u> </u>	734		<u> </u>	J	l
22	DISCHARGE CONDITIONS:						
23	PRESSURE (psia) *		22.1				
24	TEMPERATURE (OF)				1		
25	ng (Path Exponent, PTC-10)	J			<u> </u>	1	
26	COMPRESSIBILITY (Z2) OR (Zavg)	Ĺ			<u> </u>	<u> </u>	
27			,				
28	_ bhp REQUIRED (Atl Losses Incl.)				<u> </u>	L	
29	SPEED (rpm)				<b>.</b>	l	
30	PRESSURE RATIO (R)	<b></b>			1		
31	VOLUMETRIC EFFICIENCY (%)					ļ	<b></b>
32	SILENCER AP (psi) INLET/DISCHARGE				/_/		
33	PERFORMANCE CURVE NO.	L		<u> </u>	<u> </u>	<u> </u>	<b>i</b>
34	PROCESS CONTROL:						
35	METHOD DEPPASS FROM	10			YPASS: ON	IANUAL OA	UTO
36	SPEED VARIATION FROM			TO			
37	C OTHER						
38	SIGNAL C SOURCE						
39	O TYPE						
40	RANGE FOR PNEUMATIC C	ONTROL	rpm AT	(Paid	AND	rpm AT	Reig
41	OTHER	<del></del>					
42							
43							
44							
45							
46							
47							
40						<b>*</b> *	
49						<u>.</u>	
50						E.	
51					1	4.	
52	*AT CUSTOMER CONNECTIONS TO SILENCERS	3					
			^		^		
53	Prepared: S/2 Approved: Date:	414/119	Rev.	1 2	Rev. 🛆 🛚	Rev.	$\Delta$

A109 04 0787.TP2 5.1/1 REV 4

THE LUMMUS COMPANY E LIMBUR Bloomfield N. J. 4/14/14 52 DWG. NO. DATE MADE CHKD APPR. ISSUE A106 03 0776-1 REV 1

DESIGN COMPUTATIONS FOR VACUUM FACICAGE FOR 800 AFEA JOB\_\_ ACCT. 05571 GAS FEED COMPONENT wry. AIR 86.0 1.0 PHENOL H20 3.0 11. 0 502

A105 03 0776-1 REV.1

THE LUMMUS COMPANY

Bloomfield, N. J.

5/4

CHKD.

DWG. NO.

### **AREA 850**

CLIENT: DOE

PROJECT: 5571

LOCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

21-Mar-89

08:54 AM

EQUIPMENT

PCS. \$ EQUIP.

**♣ COMM** 

\$ COMM

**HEATERS** TOWERS INTERNALS REACTORS **EXCHANGERS VESSELS** TANKS **FILTERS PUMPS** COMPRESSORS

PACKAGE UNITS

TOTAL

4	\$115	100%	\$115
	\$281		
11	\$167	120%	\$200
9	\$25	120%	\$30
3	\$127	808	\$102
23	\$173	1109	\$190
50	\$888		\$637

### **SUMMARY**

**EQUIPMENT** 

\$888

COMMODITIES

\$637

**LABOR** 

\$471 (10% EQUIP,60% COMM)

INDIRECTS

\$471 (100% LABOR)

**ENGINEERING** 

\$2,000 (800/PC X \$50)

SUBTOTAL

\$4,468

CONTINGENCY

\$894 (20%)

TOTAL

\$5,361

							(OTTO YORK PRORA				
₩.	\$28,800	\$27,000	\$19,800	\$39,000	\$114,600	W	\$250,000 (	\$16,000	\$6,000	000'6\$	\$281,000
8/LB	\$1.80	\$1.80	\$2.20	\$6.50	TOTAL	\$/FT2	НОГД	\$40.00	\$40.00	\$90.00	TOTAL
WEIGHT MATL.		15000 CS	SO 0006	e000 ss		FT2 MATL	16000 CS	400 CS	150 CS	100 SS	
	DA-851 EXTRACTOR COL.	DA-852 HEXANE COL.	DA-853 METHANOL COL.	2A-854 DRYING COL.			DB-851 EXTRACTOR COL.	DB-852 HEXANE COL.	DB-853 METHANOL COL.	DB-854 DRYING COL.	

		FT2	MATL	\$/FT2	€04
<b>EA-8</b> 51	HEXANE REBOIL.	665	665 cs/cs	\$29.00	\$19,285
EA-852	HEXANE COND.	1320	cs/cs	\$15.00	\$19,800
<b>EA-853</b>	NEUTRAL OIL COOL.	17	cs/cs	\$300.00	\$5,100
EA-854	METHANOL REBOIL	737	CS/18-2	\$28.00	\$20,636
<b>EA-855</b>	METHANOL COND	910	cs/cs	\$15.00	\$13,650
<b>EA-8</b> 56	METHANOL COL. BITMS. COOL	192	cs/cs	\$42.00	\$8,064
<b>EA-857</b>	DRYING COL. REBOIL	434	SS/18-2	\$88.00	\$38,192
<b>EA-858</b>	DRYING COL. COND.	129	ss/ss	\$175.00	\$22,575
<b>EA-859</b>	CRUDE CRESYLIC ACID COOL.	16	cs/cs	\$75.00	\$6,825
<b>FA-860</b>	65% METHANOL COOL.	106	so/so 901	\$70.00	\$7,420
EA-861	METHANOL COL. INTERCHANGE.	29	cs/cs	\$100.00	\$5,900

TOTAL \$167,447

BBLS MATL 224 CS	327 CS 2X4176 CC
TANK	C ACID MONTH TANK
FB-851 HEXANE STORAGE FB-852 CRUDE CRESYLIC	RESYL

•	\$12	\$14
7887S	\$55.00	\$12.00
S	S	cs
224	327	2X4176

**OTAL** \$127,259

DOE JET FUEL

				•
GA-851, EXTRACTOR BITMS. PUMP	<10HP	cs		\$15,000
GA-852, HEXANE COL. BITMS.	<10HP	cs		\$15,000
GA-853, HEXANE FEED	<10HP	cs		\$15,000
GA-854, HEXANE MAKE UP	<10HP	cs		\$15,000
GA-855, METHANOL COL. BITMS	<10HP	cs		\$15,000
GA-856, METHANOL COL. REPLUX	<10HP	cs		\$15,000
GA-857, DRYING COL. FEED	<10HP	cs		\$15,000
GA-858, DRYING COL. BITMS	<10HP	cs		\$15,000
GA-859 CRUDE CRESYLIC ACID	<10HP	S		\$7,500
GA-860, DRYING COL. COND.	<10HP	cs		\$15,000
GA-861, 65% NETHANOL FRED	<10HP	cs		\$15,000
CA-862, CRUDE CRYSYLIC ACID FEED	<10HP	cs	11	\$15,000
		1	TOTAL	\$172.500

INCLUDED W/EXTRACTOR

GD-851 MIXER

VESSEL NO 24 24 come with										
VES	EL NAM									
	ETER _	7 0	M-In &	fi-in						
VERT	' HT	2: -:	R-n SKIRT	ft-4n						
	Z LENGT			M4n						
OPE	TEMP		3F 80TT							
	TEMP	TOP	* BOTT	"F DRUM"F						
MOR	M OPER	ME\$5 _								
	OPER PR		MELL PRIG	In DECKS IN						
COM										
DES	7EMP	<b></b> ;	·*							
	PRESS _		paig VAC							
	S ELIP		DISHEC 00	NE FLAT						
CODE	ASME		AP	OTHER						
STRE	SS RELIE	VED YES	0006							
	OGRAPH									
EART	HOUARE		WIND							
MATE SHELL THE THE HASHATION CONSERVED TO PROTECTIVE NONE DECK MATE										
NOZZLES FLG CLASS COUPL CLASS										
ITEM NO SIZE SERVICE & SYMBOL										
NO	REGD	in.	MANHOLE							
,			MANHOLE	FLANGED NOZZLES ARE						
3				NUMBERED 1-50 FOR COUPLING ADD						
4				FOR COUPLING ADD						
5	_		HANDHOLE	2 TO MULELE NO						
6										
7			VAPOR OUTLET TO							
			VENT							
10			TO VACUUM EQUIPM	IENT						
11	_		REFLUX IN FROM	F. * 4						
12			FEED FROM	4:3						
13			FEED FROM	- 5-						
14			TO (REBOILER) IREB							
15			FROM RESOILER	•						
16	=		EQUALIZING LINE WI	TH						
17			90TTOM 0	NTLET TO						
18			LIQUID OU	TLET TO						
			DRAWOFF	10 24.5.4						
20		<del></del>	METURN F	70 <u>ú</u>						
52			RETURN F	BOM						
23	_		DRAWOFF	10						
24	. —		RETURN F							
25			MEFLUX DE	MAWOFF TO						
26			MEFLUX IN	FROM						
27			REFLUX DE	AWOFF TO						
28			PROCESS STEAM							
29 30	_		STEAM OUT (SO)							
31			DRA H							
32			SAMPLE CONN IS: (	COOLER (SC)						
33			SAFETY VALVE IPSV							
34			SAFETY VALVE IPVS	v (vsv)						
2*			THIS COMMECTIO	•						
<b>36</b>	_		PRESSURE GAGE (PC							
37 38			PRESSURE CONTROL	LLER (P O						
39			FIEDOUNE IMP (PI)							
40			TEMPERATURE INDIC	ATOR (TI)						
41			TEMPERATURE CONT	TROLLER (TC)						
42			TEMPERATURE RECO	DRDER (TR)						
43			TEMPERATURE WELL	. rwn						
44										
45			GAUGE GLASS (LG)							
46 47	<del></del>		EXTERNAL LEVEL							
48			INTERNAL LEVEL							
49	_									
90	_									
				-						
NOTE	5									
4	نزد ۵ ـ	ie :	075 2.4, <u>6</u>	THE METOR TO MA						

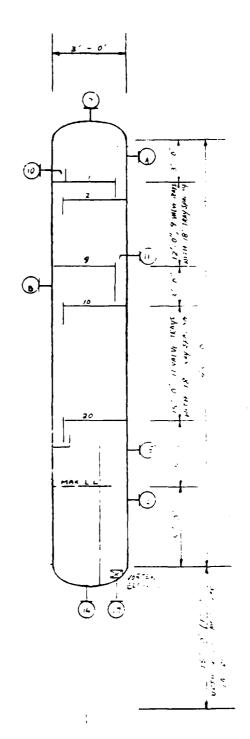
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						!	THE LUMMUS COMPANY				
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	41141	FOR TATIF 4	μ.				PROCESS VESSEL SKETCH				
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VESSEL NAME TENT OF EMAINEMENT OF THE PROPERTY	THE SAIRT  THE SAIRT  F BOTT  F BOTT  PRIG SAIR  DRIG GAI  DRIG CONE  API  CODE  CODE  CODE  CODE  LINES  LINES  VALUES: 3004  COUPL CLI  SERVICE & SYMBOL  MANMOLE  MANMOLE  MANMOLE  MANMOLE  FLA  NUM  FOR	THK NO  NGED NO.  SSS  THK NO  NGED NO.  SSS  THK NO  NGED NO.  SSS  TO GOVERN  THO  THR NO  T	AT	mph in		10 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2	13) - 15 - 15 - 15 - 15 - 15 - 15 - 15 - 1
					1			
								THE LUMBIUS COMPANY
A MINI							LOCA JOB N	10 12: //
A LOU	TMK 4	PROL	-		<u> </u>		Т	BEL SKETCH
REV PATE	DESCRIPTION	ENGA	PROJ ENGA	AFFR	AFFR	VESSEL NO DA-152	DW	G \$K8 -

8307 0362 11

VESSEL NAME  DIAMETER  VERT HT  HORIZ LENGTH  HEADS ELIP  CODE ASME  EARTHOUAKE  HATL SHELL  HASULATION CONSEL  DECK MATL	
NOZZLES FLG CLASS	
NO REGIO IN	SERVICE & SYMBOL
, <u>2</u> , 6	MANHOLE
;	MANHOLE FLANGED NOZZLES ARE NUMBERED 150 FOR COUPLING ADD
:==	HANDHOLE SO TO NOZZLE NO
6	
$\vec{r} = \vec{r}$	VAPOR OUTLET TO EA-255
•	TO VACUUM EQUIPMENT
10 2	REFLUXIN FROM GA: 256
11	FEED FROM <u>\$4 - 25</u> FEED FROM
$\cdot \cdot \cdot = =$	- FEED FROM
14 <u> </u>	TO (REBOILER) (REGISTRATE) & A 25% FROM REBOILER &4 (834
15	ECC. A. 17-MG CIME WITH
· 12	
'6	LIQUID OUTLET TO
r	RETURN FROM
2 <sup>2</sup>	DRAWOFF TO
27	DRAWOFF TO
24	RETURN FROM
" — —	REFLUX DRAWOFF TO
2'	REFEGA DARMOFF (D
*	PROCESS STEAM
×	STEAM OUT ISO
3,	_ DRAIN
" — —	SAMPLE CONNISS, COOLERISC SAFETY VALVE IPSV
» ·	_ SAPETY VALVE (PVSV. (VSV
" <u> </u>	UTILITY CONNECTION PRESSURE GAGE IPGI
5,	PRESSURE CONTROLLER IPC.
*	_ PRESSURE TAP (PT)
39 <u> </u>	TEMPERATURE INDICATOR (TI)
· — —	TEMPERATURE CONTROLLER (TC)
<u> </u>	TEMPERATURE RECORDER (TR- TEMPERATURE WELL (TW)
<b>"</b> — —	
<u> </u>	GAUGE GLASS (LG)
# <u> </u>	EITERNAL LEVEL
4 = =	LEVEL ALARM (LA)
* = =	
HOTES - = =	. Ge = 127 (AVG. & Here's tamp



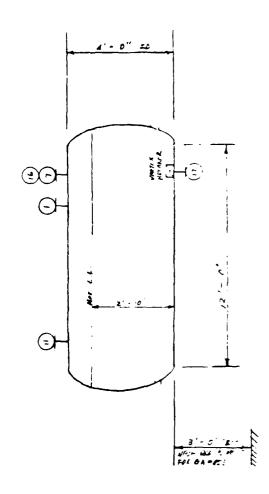
							THE LUMBIUS COMPANY
				1	j	TITLE TET FULL PROJECT CLIENT ASCISTOS GREEN MARE LO PROJEO 100	CATION FEWERY NET SECTION 600 0557/
<b>△</b> 11:41	F02 TANK 4	<u>", ·</u>	_			PROCESS V	ERREL SKETCH
REV ISSUE DATE	DESCRIPTION	PROL	PROJ ENGR	APPR	APPR	VESSEL NO DA - EC	DWG SK8 -

NITES MALIFOR TES COOR CAST COOR CAS	VERREL NO DA - 854 COM WITH				i i
TOTAL LAS SERVICE IN THE COLUMN TO THE STATE OF THE STATE	VERT HT 32 - 4" TO No 8 VERT HT 32 - 4" No BURY	(5 - 0".	_ **		;
MOTES LAS AND CONTROLLER OF CONTROL OF	OPER TEMP: TOP	7 0000			2'-6"
DESTRUM #4.0  WHO DENED #37M COME FLAT TREE  WHO OF THE DONE #57M COME FLAT TREE  WHO OF THE DONE MAINTO TES COME  LATTICIONATE JOSE WHO OF THE WORLD WAS AND	MAX TEMP TOP TO TO TO TO THE STATE TO THE ST	13 AC 74		,	10
DESTRUM #4.0  WHO DENED #37M COME FLAT TREE  WHO OF THE DONE #57M COME FLAT TREE  WHO OF THE DONE MAINTO TES COME  LATTICIONATE JOSE WHO OF THE WORLD WAS AND	MAX OPER PRESS pag OR CORROSION ALLOW SHELL IN CHE	<b>78</b>	padd 00		,
HADS \$LUPYD PTS DOOP OF PAN TOP TO THE WARREN TO THE WARREN CONTROL OF THE CONTRO					
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STREES RELIVED YES  COOK  LANTHOLIARE  WHICH COOK  WHI		PLAT THER	- <u></u>		T
LANT-QUARTE WOOD OF THE WAS SET AND A SET AND	STRESS RELIEVED YES CODE				
MOUNTED COMPRESSION ASSETS ASS	EARTHOUARE WIND		_		
PECH MAT LEGIST MALVEL DAMES  MODIFIED TO GROUP CLASS  TO MACHOLE  MANHOLE	MATE SHELL 304 SS LINERT		<b>•</b>		$\sim$ 1 $\sim$ 1 $\sim$ 1 $\sim$
TIEL NO BEZ SENACE & SPISSOL  NO RECO II MANHOLE	DECK MATE 10415 MENTS AND S				
TELL NO BEZT SERVICE & STABOL  NO RECO IN  RECO IN  BAAMCLE  MANIFOLE  MANIF	HOZZLES FLE CLASS	×			
MANIFOLE  MANIFO					
MANDHOLE    MANDHOLE	NO REGO IN				2
MANDHOLE    MANDHOLE	2 MANHOLE PLAN	GED MOZZI ES	AME		
A VANCH QUILET TO	POR (	COUPLING ADD	,		<u> </u>
A VANCH QUILET TO	S I E HANDHOLE IN TO	- HUZZLE NO			
1		- <u>F</u> 5 8			
THE PROPOSE OF THE PR	B VENT				
PED FROM  PED FROM  PED FROM  PED FROM  PED PROM  PED PR	10 REFLUX IN FROM	,			9
1	12 FEED FROM				
TEMPERATURE MOCATOR ITS  SELENT VALVE (POST MED)  SELENT VALVE (POST ME	13 FEED FROM	EA -857			, , , , , , , , , , , , , , , , , , ,
BOTTOM QUITLET TO LIQUID QUITLET TO LIQUID QUITLET TO DAWOFF TO RETURN FROM DRAWOFF TO DRAWOFF TO DRAWOFF TO DRAWOFF TO DRAWOFF TO RETURN FROM DRAWN SE PROCESS STAIN X STEAM QUIT (RO) DRAWN S FEAR QUIT (RO) DRAWN LITH TO CONNECTION PRESSURE CARE (PO'S) (VSX) ITH TEMPERATURE MOCATOR (TO) TEMPERATURE MOCATOR (TO) TEMPERATURE ACCORDER (TO) S TEMPERATURE ACCORDER (TO) TEMPERATURE ACCORDER (TO) S TEMPERATURE	15 _ FROM REBOILER EA-25				Ì .
USUND OUTLET TO DANGE FTO DIAMOF	17 1 1/2 SOTTOM OUTLET !	70			
RETURN FROM  DRAWOFF TO  RETURN FROM  DRAWOFF TO  RETURN FROM  STEMPORT FROM	18 LIQUID OUTLET TO	·			
DRAWOFFTO DRAWOFFTO REFLUX IN FROM R	2CRETURN FROM _				: 3
DAAWOFF TO  RETURN FROM  RETURN					· · · · · · · · · · · · · · · · · · ·
REFLUX DRAWOFF TO REFLUX IN FROM REF	23 DRAWOFF TO				<del>                                   </del>
MEPLIX ENAMOSP TO  MAIL L	25REFLUX DRAWOFF				
PROCESS STAM  STAM OUT (SO)  DRAIN  32	75				
STEAM OUT (SO)  ORAIN  SI ORAIN  SAMPLE CONN (S) COOLER (SO)  SAMPLE CONTROLLER (POS) (NSW)  STUTILITY COMMECTION  MAK L L  SO  MAK L L  SO  MAK L L  SI  MAK L L  MAK L L  SI  MAK L L	28 REPLUX IN FROM				
BAMPLE COME (S) COOLER (BC)  BAFTY VALVE (PVSV) NSV)  M BAFTY VALVE (PVSV) NSV)  JI BAFTY VALVE (PVSV) NSV)  JI BAFTY VALVE (PVSV) NSV)  JI BAFTY COMMECTION  MESSAURE COMTROLLER (P)  G MESSAURE COMTROLLER (P)  G MESSAURE COMTROLLER (T)  AC TEMPERATURE MOCATOR (TR)  TEMPERATURE RECORDER (TR)  TEMPERATURE WELL (TW)  AC EXTERNAL LEVEL  G BAUGE OLASS (LG)  G EXTERNAL LEVEL  MITERNAL LEVEL  AC HITERNAL LEVEL  MITERNAL LEVEL  AC LEVEL ALARM (LA)  BU SP 4C = 0.89 (Av4) @ GMASTING T2 MP	X STEAM OUT (SO)				· ,
SAFETY VALVE (PMS) MSVN  MEARETY VALVE (PMS) MSVN  UTILITY CONNECTION  PRESSURE CADE (PG)  PRESSURE CADE (PG)  PRESSURE CADE (PG)  TEMPERATURE MONCATOR (TI)  TEMPERATURE MONCATOR (TI)  TEMPERATURE CONTROLLER (PG)  TEMPERATURE RECORDER (TIV)  TEMPERATURE WELL (TIV)  STATEMENT SECONDER (TIV)  TEMPERATURE WELL (TIV)  STATEMENT SECONDER (TIV)  STATEMENT SECO	12 SAMPLE CONN (S) COOLER	<b>6</b> 0			
JULITY CONNECTION  M PRESSURE CADE (PG)  PRESSURE CONTROLLER (P	33 BAFETY VALVE (PBV)				
TEMPERATURE HIDICATOR (TI)  TEMPERATURE RECORDER (TR)  TEMPERATURE RECORDER (TR)  TEMPERATURE WELL (TM)  G  G  G  G  G  G  G  G  G  G  G  G  G	35 UTILITY CONNECTION				I HO
## PRESSURE TAP (PT)  ## TEMPERATURE MODICATOR (TI)  ## TEMPERATURE CONTROLLER (TI)  ## TEMPERATURE RECORDER (TIV)  ## SETTEMBALLEVEL  ## GAUGE GLASS (LG)  ## EXTERNAL LEVEL  ## LEVEL ALARM (LA)  ## LEVEL ALARM (LA)  ## TEMPERATURE WELL (TW)  ## TEMPER	37 PRESSURE CONTROLLER IP.	a			
TEMPERATURE MODICATOR (T)  TEMPERATURE CONTROLLER (T C)  TEMPERATURE RECORDER (TR)  TEMPERATURE WELL (TW)  SE	<b>x</b>				
TEMPERATURE RECORDER (TR)  TEMPERATURE WELL (TM)  STEMPERATURE RECORDER (TR)  STEMPERATURE RECORDER (TR)  STEMPERATURE RECORDER (TR)  STEMPERATURE WELL (TM)  STEMPERATURE WEL	40 TEMPERATURE INDICATOR (	To .			<i>i</i> v,
## BAUGE GLASS (LG) ## EXTERNAL LEVEL ## LEVEL ALARM (LA) ## LEVEL ALARM (LA) ## LEVEL ALARM (LA) ## COTES LA SP 42 * 0.89 (Ave.) @ genering 72 MP	42 TEMPERATURE RECORDER (		•		
## BAUSE DLASS (LG) ### BETEMMAL LEVEL ### HTEMMAL LEVEL ### LEVEL ALARM (LA) ### LEVEL ALARM (LA) ### HOTES La Sp 4x = 0.89 (Av6.) @ gpasting 72 mp	4				IN JAMES JAM
17 - INTERNAL LEVEL 48 - LEVEL ALARMILLA 50 - 50 - 50 - 6.89 (Ava) @ gassting 72 mp	45 GAUGE QLASS (LQ)				
NOTES LE SP 42 = 0.89 (Ava) @ appenting 72 mp	47 / INTERNAL LEVEL				<b>↓</b> ↓ ↓ ∴
NOTES LE SP 42 = 0.89 (Ava) @ appenting 72 mp	45 LEVEL ALARM (LA)				(b) (7) Q;
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THE LUMBING COMPANY THE LUMBING COMPANY THE BY PAUL PROPERTY COLUMN AND DISC. SAME AND LOCATION BE VLAN , MEM 2013** PROPERTY AND THE PROPERTY VERSEL SKETCH	MEY BATE DESCRIPTION	700. 700. 200.	****	~~~	VESSEL NO DA ATV DING SKS -

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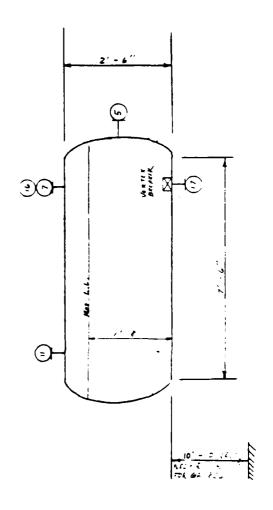
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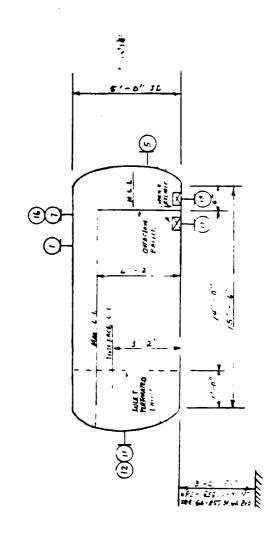
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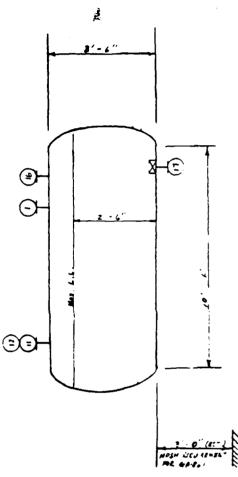
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								CLUMBAUS COMPANY
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								THE LUMBERS COMPANY
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THE LLAMAGE COMPANY

CHANGE BUT FOR PROJECT

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# <del>_</del> '	EMPERATURE WELL (TW)	
<b>4</b> 9	LAUGE GLASS (LG) ETTERNAL LEVEL	
	MTERNAL LEVEL	
== '	EVEL ALARM (LA)	
MOTES L	= 10: @ Francing Tomp	

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								THE LUMBRUS COMPANY
							TITLE JET FULL PROJECT CLIMIT MOCREDIC GENT MAGE	LEGATION BENEAU, MARTIN JAZA"
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$\Delta$	ile.	far the 4	<b>1</b>				PROCESS	VENEL SKETCH
<b>~</b> *	24	BEEGN/TO /	11	11	*	*	VBBL 40 FA- 852 A E B	\$100 \$120 -

1104 OF 05.76 1974 MMEV 1

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	and a forest	A A TAN		i		î						<u>'</u>	1	Ī	77.77	-	1	17				

#### **AREA 900**

CLIENT: DOE

PROJECT: 5571

LOCATION: BEULAH, ND.

PROJECT: JET FUEL

DATE/BY:

21-Mar-89

09:16 AM

EQUIPMENT

# PCS. \$ EQUIP.

P. \* CO

**COMM** 

\$ COMM

\$1,059

HEATERS
TOWERS
INTERNALS
REACTORS
EXCHANGERS
VESSELS
TANKS
FILTERS
PUMPS
COMPRESSORS
PACKAGE UNITS

į		

5	\$453	100	\$453
	\$218		
16	\$220	110	\$242
4	\$19	1204	\$23
6	\$69	80\$	\$55
28	\$210	110	\$231
2	\$50	110%	\$55

\$1,239

TOTAL

## **SUMMARY**

61

**EQUIPMENT** 

\$1,239

COMMODITIES

\$1,059

LABOR

\$759 (10% EQUIP,60% COMM)

INDIRECTS

\$759 (100% LABOR)

**ENGINEERING** 

\$2,440 (800/PC X \$50)

SUBTOTAL

\$6,257

CONTINGENCY

\$1,251 (20%)

TOTAL

\$7,508

	WEIGHT MATL		\$/IB	અ	
DA-901 PHENOL/ORTHO COL	100000 CS		\$1.40	\$140,000	
DA-902 PHENOL COL	35000 CS		\$1.60	\$1.60 \$56,000	
DA-902B PHENOL COL	35000 CS		\$1.60	\$56,000	
DA-903 M, P-CRESOL COL.	86000 CS		\$1.50		
DA-904 XYLENOL TOPPING COL.	45000 CS		\$1.60	\$72,000	
			TOTAL	\$453,000	
	ET2 MATE	뒤	\$/FT2	જ	
DB-901 PHENOL/ORTHO COL	4800 CS/	CS/SS VALVES	\$18.00	\$86,400	
DB-902 PHENOL COL	/SD 006	CS/SS VALVES	\$18.00	\$16,200	
DB-902B PHENOL COL	1000 CS/	CS/SS VALVES	\$18.00	\$18,000	
DB-903 M, P-CRESOL COL.	3500 CS/	CS/SS VALVES	\$18.00	\$63,000	
DB-904 XYLENOL TOPPING COL.	1900 CS/	CS/SS VALVES	\$18.00	\$34,200	
			TOTAL	\$217,800	

		FT2	MATL	\$/FT2	88
EA-901 PHE	PHENOL/ORTHO COL. REBOIL	190	cs/cs	\$27.00	\$21,330
EA-902 PHE	PHENOL/ORTHO COL. COND	522	sɔ/sɔ	\$19.00	\$9,918
EA-903 PHE	PHENOL COL. REBOIL	300	CS/18-2	\$95.00	\$28,500
EA-904 PHE	PHENOL COL COND	286	cs/cs	\$28.00	\$8,008
EA-905 M,P	-CRESOL COL. REBOIL	750	CS/18-2	\$28.00	\$21,000
EA-906 M, P	M, P-CRESOL COL. COND	520		\$60.00	\$31,200
EA-907 XYL	ENOL TOPPING COL REBOIL	374	CS/18-2	\$90.00	\$33,660
EA-908 XYL	XYLENOL TOPPING COL COND	236	ss/ss	\$120.00	\$28,320
EA-909 PHE	PHENOL/ORTHO COL. INTER	51	cs/cs	\$100.00	\$5,100
EA-910 PHE	PHENOL COL. BITMS. COOL	68	cs/cs	\$90.00	\$6,120
EA-911 XYL	XYLENOL TOPPING COL. BITMS	35	cs/cs	\$125.00	\$4,375
EA-912 M,P	M, P-CRESOL PRODUCT COOLER	135	cs/cs	\$50.00	\$6,750
EA-913 0-C	O-CRESOL TOPPING CCL OH.	16	cs/cs	\$200.00	\$3,200
EA-914 0-C	0-CRESOL PRODUCT COOL.	46	cs/cs	\$110.00	\$5,060
EA-915 XYL	XYLENOL COL.INTER.	18	cs/cs	\$200.00	\$3,600
EA-916 2,4	2,4/2,5 XYLENOL PROD. COOL	22	cs/cs	\$200.00	\$4,400

DOE JET FUEL

\$220,541

TOTAL

co)	\$2.75 \$5,500 \$4.00 \$4,000 \$2.75 \$5,500 \$4.00 \$4,000	\$19,000
8/LB	જ જ જે જ	TOTAL
WEIGHT MATE	2000 CS 1000 CS 2000 CS 1000 CS	
	FA-901 PHENOL/ORTHO REFLUX DRUM FA-902 PHENOL REFLUX DRUM FA-903 M/P-CRESOL REFLUX DRUM FA-904 XYLENOL TOPPING REFLUX	

DOE JET FUEL

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\$/BBL \$ \$55 \$12,320 \$65 \$8,775 \$65 \$8,775 \$50 \$21,500 \$90 \$8,100 \$65 \$8,775
BBIS MATL 224 CS 135 CS 135 CS 430 CS 90 CS 135 CS
FB-901 O-CRESOL TOP. FEED DAY TANK FB-902 XYLENOLS INT. DAY TANK FB-903 O-CRESOL DAY TANK FB-905 M,P-CRESOL DAY TANK FB-906 2,4/2,5-XYLENOL DAY TANK FB-907 MIXED XYLENOLS DAY TANK

GA-901&S	GA-901&S PHENOL/ORTHO BITMS	<10HP	S	\$15,000
GA-902&S	PHENOL/ORTHO REFLUX	<10HP	S	\$15,000
GA-903&S	PHENOL BITIMS	<10HP	cs	\$15,000
GA-904&S	PHENOL REFLUX	<10HP	cs	\$15,000
GA-905&S	M, P CRESOL BITMS	<10HP	S	\$15,000
GA-906&S	M, P CRESOL REFLUX	<10HP	cs	\$15,000
GA-908	O-CRESOL TOPPING	<10HP	cs	\$7,500
<b>GA-909</b>	MIXED XYLENOL	<10HP	cs	\$7,500
GA-910	2,4/2,5-XYLENOL	<10HP	cs	\$7,500
GA-911	M, P-CRESOL	<10HP	cs	\$7,500
GA-912	XYLENOLS	<10HP	S	\$7,500
GA-913 O-CRESOL	O-CRESOL	<10HP	cs	\$7,500
GA-914£S	PHENOL COL. INTERM.	<10HP	cs	\$15,000
GA-915&S	XYLENOL TOPPING	<10HP	cs	\$15,000
GA-916&S	XYLENOL TOPPING REFLUX	<10HP	S	\$15,000
GA-9174S	O-CRESOL TOP. COL. FEED	<10HP	cs	\$15,000
CA-918&S	XYLENOL COL. FEED	<10HP	cs	\$15,000

DOE JET FUEL

GB-901, S VACUUM PUMP

\$210,000

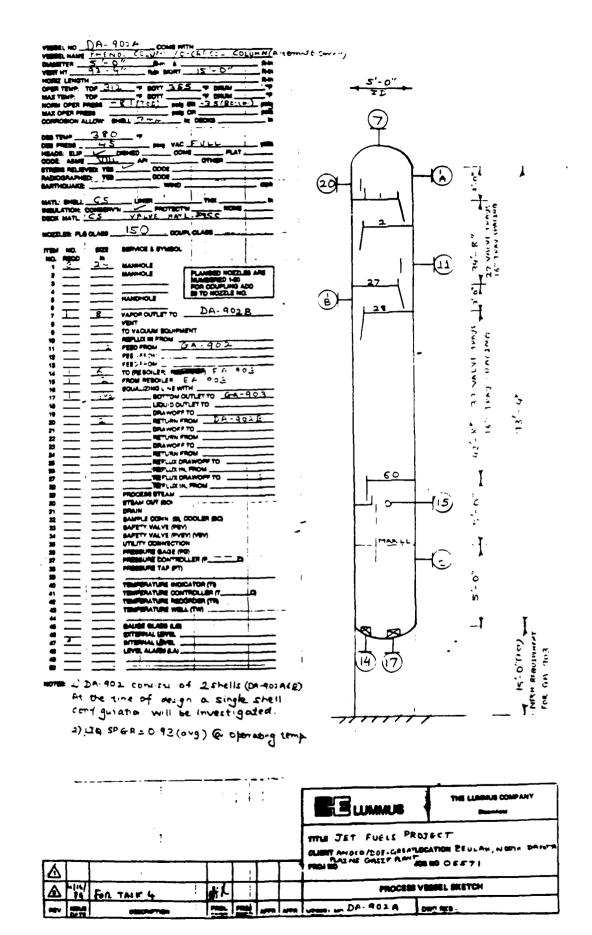
TOTAL

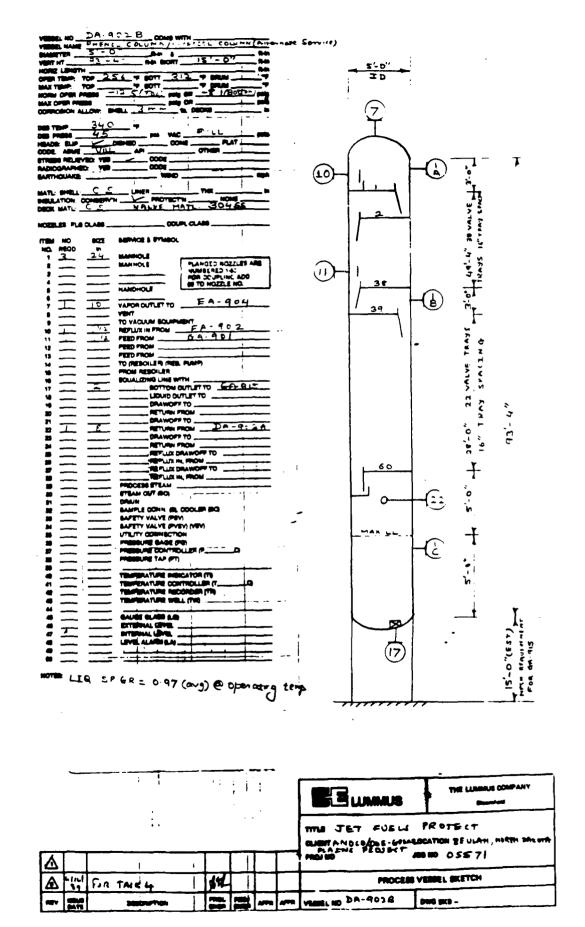
\$50,000

TOTAL

VERSE NO DA-901 COMB WITH VERSE NAME PHENDL/PRINC COLUMN /8-CERSEL TO PEN (A)	, col.
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6 BITBOAL LEVEL 6 LEVEL ALARM EA	
LIE SP GR=0 91 (avs) @ Openasing temp	15.0 (EET)
	THE LUMBAU COMPANY
	WILL JET FUELL PROJECT  BLOOM THE CONTROL OF THE PROJECT IN THE PR
	PROCESS VESSEL SKETCH
AL IN FOR THAT 4 . IT.	venerum DA-901 sue sea -

•	DA SUNIL	VALVE TE JSCO AF ACLO RES	TOTAL COMPUTER PUBLICAM CONTRACTOR CONTRACTO	• 4-9/19 11•	77. 77. 17. 10.	PLANT OF AND PE	25 (1986) 1 (19-53)	4 JS JUA 03 ES	1 5571	
•	LATOUT OTHENSTIMS							JEPT 502 . OFFICE	E . 110 -	
•	TRAY SPACING, INCHES	₽ E		(11.09) (2XF 11.04551	1100.1.0	\$F. 1	Chafa mtamifiu, Friceis	00•+9		•
•	DE 51 G# 1040 S	VAPOR RATE LBS/IM	VAPOR DENSITY LBS/FT3	}	LIUJIO RAIF LISZAG	LIQUED DENSITY	SUPFACE TENSION			1
•	MARINUM .	33262.03 DVC2DES.ICH_IO_100.	016/0.	10284-00 VAPOR_AND TO 107-0 DZ0	10284.00 10 109.0 070	· -		.36900		
	of others	Personne de La La La La La La La La La La La La La	.13300 	ASS	15211.50 10 70.0 070	; <u>5</u>		19-30 -27203		
	BOUNCOMEN LECATION		ĭ	1 = \$10.				TAME CLAUSO TRAY	:	
				SE SLOPING	- E	1				
<u>ال</u> محدة	TOPIC SHEET IN 1.	MATERIAL DISCOURS	TIMBUES (NOTE 11.	į	_		;		٠	•
atau O	DOTLES WESN HER	E. ABEL ABECK		(0(-1					;	1
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thu	1	med non L	PER DOWNCONER	ER PLATSA. N	NUTE 1 -DIP	-DIMENSIUM ABOYE TRAY FLOOM.	TOTE	F HOWIZONTAL DISTANCE		
31/1	MOTE S'MONDERB.EN B. ) AGRER TO THE APPLICAL	. I ABFER TO	THE APPLICABLE	E MESSAGES	THE DIT	BLE MESSAGES ON THE DIAGNISTICS SHEET	. VOTE 6 - 0 IN	* INDICATES SPECIAL TRAY PEATURE	EATURE	1
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GELFASE OF DATED APR 25 1986 UFSIGN - FIND RUUNUED IN SKE CE LUMMUS VALVE TRAY COMPUTER PRIJURAM 4-9219
BY SUNIL
COLUMN 932 CRESYLIC ACID RECOVENY

(

BAICH LUMMJS JUB UN ESTIMATE DEPT 302 JFFICE

60.00

INSTOR TOWER DIAMET RITCHES SXF (1-PASS) TRAY SPACING. INCHES LATOUT DIMENSIONS TYPE OF FLOW

LIGGED VISCOSITY IBASED ON OVERDESIGN TO 100.0 0/0 OF VAPOR AND TO 100.0 U/1 OF LEWILD NUMENAL RATES FUR MAXIMUM LOADED TRAVE CENTIPOISE . 36900 LIQUID DENSITY SURFACE TENSION DYNES/: 4 21.95 L85/F13 61.30000 LIGJIJ RATE 14200.00 LBS/HR VAPOR DENSITY LBS/FI3 .02740 VAPOR RATE LBS/48 15450.03

DESIGN LOADS

MAXIMUM -

-13500 17104-50 56-55000 71-48 -27400 70-0 0/0 0F LIJUID NJMINAL RATES FJR MINIMUM LJANEU TRAVI 18172.50 TORNOUM TO MINIMUM -

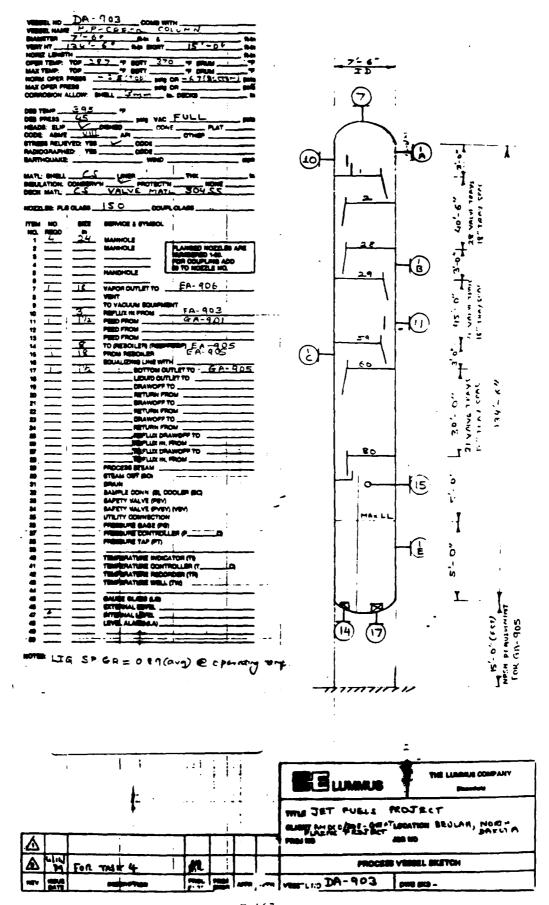
2= SLOPING +INLET WEIR 6.303 1.253 1.500 1 = \$10 (NOTE 1) DIMENSIONS AT TOP OF DOWNCOMER, INCHES DOWNCOMER LOCATION DOWNCOMER TYPE

36.303 (NOTE 2) DOWNCOMER MIDTH
DOWNCOMER PLATE TO SHELL DISTANCE
OUTLET WEIR HEIGHT
PMEIGHT\_OF OUTLET WEIR NOTCH
OUTLET WEIR LENGTH CHORD LENGTH AT DOWNCOMER PLATE

.753 1.253 6.303 36.303 36.303 4.253 3.785 (NOTE 1) ( NOTE 41 (NOTE 2) (12 STCN) (NOTE 2) INOTE DIMENSIONS AT BOTTOM OF DOWNCOMER, INCHES DOWNCOMER WIDTM
DOWNCOMER CLEARANCE
DOWNCOMER BOTTOM TO TRAY INLET
INLET WEIR WEIGHT
INLET WEIR LENGTM
DOWNCOMER PLATE
LENGTH BF DOWNCOMER PLATE
LENGTH BF DOWNCOMER PLATE
CHORD LENGTM AT INLET WEIR NJTE 3 -DIMENSIUN ABOVE TRAY FLOOR. NOTE 4 -MORIZONTAL DISTANCE MOTE 1 -PER DOWNCOMER, MOTE 2 -PER DOWNCOMER PLATE,

NOTE 5 - P INDICATES SPECIAL TRAY FEATURE

ATTACH THIS SHEET TO THE VALVE TRAY DATA STEET TO MAKE A PROCESS SPECIFICATION FOR THIS TRAY . . . . . . . . . .



VILLASE US DATED APR 25 1986 DESTUN - FIND ROUNDED ID SKE CE LUA VALVE TRAY COMPUTER PROGRAM 4-9217 BY SUMIL USED AT 12.54.01 DV 88/11/11. COLUMN 903 CRESYLIC ACTU RECOVERY

LUMMUS JOS DR ESTIMATY 5571 JEPT 302 DEFICE LTD

LAYOUT DIMENSIONS

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90.00 LIGGIO VISCOSITY CENTIPOISE 18ASED ON OVERDESIGN TO 100.0 D/O OF VAPOR AND TO 100.0 D/O OF LIUULU NIMINAL RATES FIR MAXIMUM LIBUGO TRAY) EBASED DE TURNDOMN TO 70.0 O/O OF VAPOR AND TO 70.0 D/O OF LIUCIO NUMINAL RATES FOR MINIMUM LUANDED FRAVI INSTUR TIMER DIAMETER INCHES LIQUID DENSITY SURFACE TENSION DYVESZIM Liss/FI3 53.60000 57.8 300n LIGHTU RATE 34 100 .00 11144.50 L 35/11R SXF II-PASS 14.303 VAPOR DENSITY L85/FT3 .03000 .09900 VAPOR RATE 31171.70 39900.03 LBS/HR TRAY SPACING, INCHES TYPE OF FLOW DESIGN LOADS MAKINUM = MINIMUM =

DOMNCOMER TYPE 2x SLOPING 2x SLOPING 4 STREET WEIR

.

OTHENSIONS AT TOP OF DOWNCOMEN, INCHES

ODWICGHER MIDTH

DOWNCOMER MIDTH

DOWNCOMER MIDTH

DOWNCOMER MEIGHT

OUTLET WEIGH WEIGHT

OUTLET WEIGH LENGTH

CAGNO LENGTH AT DOWNCOMER PLATE (NOTE 2) 54-303

DOWNCOMER WIDTH

DOWNCOMER CLEARANCE

DOWNCOMER CLEARANCE

DOWNCOMER BOTTOM TO TRAY INLET

INLET WEIR HEIGHT

LENGTH OF DOWNCOMER PLATE

LENGTH OF DOWNCOMER PLATE

CHORD LENGTH AT INLET WEIR (NOTE 2)

S\$500

CHORD LENGTH AT INLET WEIR

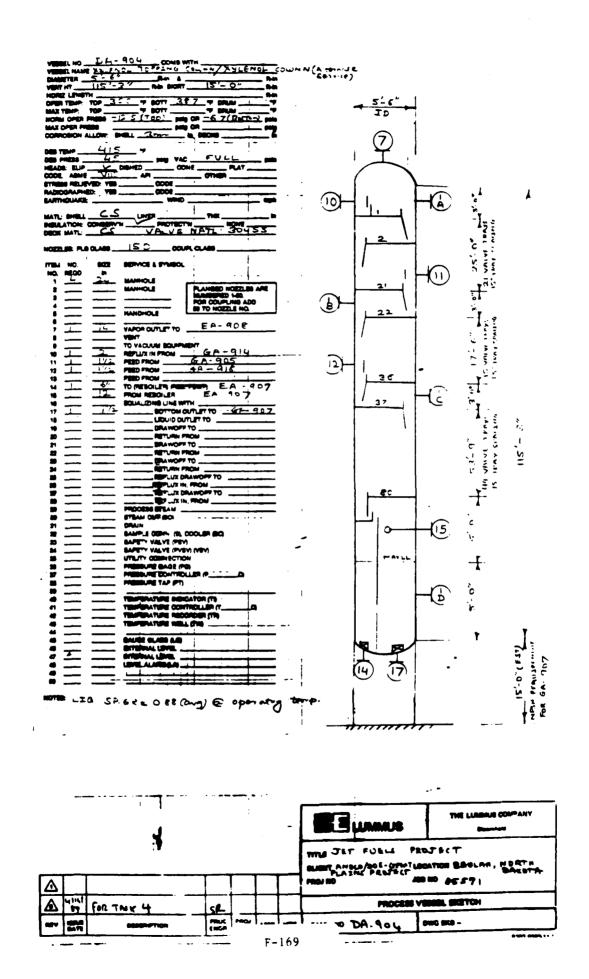
CHORD LENGTH AT INLET WEIR

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NJTE 3 -DIMENSION ABOVE TRAY FLOOR, NOTE 4 -40RIZONTAL DISTANCE MOTE 1 -PER DOWNCOMER, MOTE 2 -PER DOWNCOMER PLATE.

. ATTACH THIS SHEET TO THE VALVE TRAY DATA SHEET TO MAKE A PROCESS SPECIFICATION FOR THIS TRAY . . . .

NOTE 5 - P INDICATES SPECIAL TRAY FEATURE



75407	A 1 2 - F THE STEEL STOLET OF THE SAINA	State of the state	
OY SUNTE	JSEU AT 12.54.26 DV AB/11/11.	DESTON - FIND KIDADI D IN SKL	BOC SCHMIS JOB

UFF ICE H DA ESTEMATE

•	LATOUT DIMENSIONS						
•	TARY SPACING. INCHES	CMES	P. K.	15.303 (501) SXF (1-PASS)	ABPCJ JOJSKI	FOAER DIAVETER, INCHES	99.00
•	DESIGN LOADS	VAPOR RATE LBS/4R	VAPOR DEMSITY LUS/FI3	LIGJID RATE L SS/HK	LIQUID DENSITY SURFACE TENSION LASZETS DYNESZUM	SURFACE TENSION DYVES/29	LEGUED VISCOSITY CENTIPOLSE
•	MAXIMUM = CONT.	18703.03 OVERDESIGN T3	104 = 18703.03 .03050 17900.00 57.50000 25.30 .3640	17900.00 AND TO 100.0 0/0	S7.SOOOO	25.30 L RATES FOR MAXIM	.36400 UM LJADED FRAYI
	MIMIMUM	14318.53 M TURNDONN TO	18 14318-50 -10400 15517-70 52-00000 <sup>1</sup> 19-30 -20100 10 100000 100	15517.70 AND 10 70.0 D/U	\$2.00000° 3F LIDUID NAINA	19.30 L RATES FJR MINIM	.28100 UM LJADED FRAY)
	DOMVCONER LOCATION	101	ٽ <del>ٽ</del>	1=SID_ 2= SLOPING • INLET WEIR			
•	DIMENSIONS AT TOP OF DOWNCOMER.INCHES	DP OF DOWNCOME	11 31041	4.763			

166.68 6.153 6.753 (NOTE 2) (1 31CM) DOSMUCOMER PLATE TO SHELL DISTANCE DOSMUCOMER PLATE TO SHELL DISTANCE DUTLET WERR NOTCH OWLLET WERR LENGTH CHORD LENGTH AT DOSMUCOMER PLATE

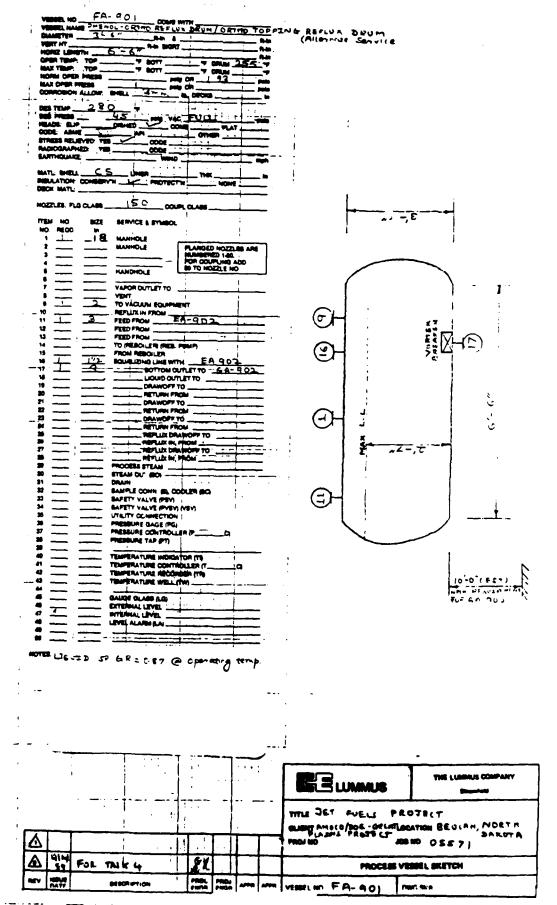
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NOTE 5 -NUMBERS IN ( ) REFER TO THE APPLICABLE MESSAGES ON THE DIAGNOSTICS SHEET . NOTE 6 - \* INDICATES SPECIAL TRAY FEATURE MOTE 1 -PER DOWNCOMER. NOTE 2 -PER DOWNCOMER PLATE. NOTE 3 -DIMENSION ABOVE TRAY FLOOR. NOTE 4 -408120NTAL DISTANCE

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THE LLEARNE COMPANY
CHAPTER

TITLE JET FUEL PROTECT
CLIENT AMOLO/DOE MEDITION REVIEW, ND
PROCESS VESSEL SKETCH

AT SAME SECONT: THE MARK APPR APPR VESSEL NO FR -902 SHE SKET.

VOIDER, NO FR-90 VOIDER, NAME O CRE BANGTIER VORTHY P - 0" HORIZ LIBRETH LOPEN TRUP: TOP HORIZ LIBRETH LOPEN TRUP: TOP HORIZ CIBRETH LOPEN TRUP: DE CODE: ADMIT BANDOGRAPHED VIS BANDOGRAPHED VIS BANTHOLIARE HORIZ LIBRETH	PPDD 1 DAY TANK AN 8 AM BAN AN	1	·	
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A	पारा	FOR THEK 4	BL				PROCESS	VESSEL SKETCH
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HEADS ELIP	AR CODE  COD  COD	rn		
## 10	SERVICE & EYMBOL  MANMOLE MANHOLE MANHOLE MANBERD 1-90 POR COURTHING ADD WARDHOLE  LAPOR LE  VENT TO VACULUM EQUIPMENT REFLIX IN FROM		14/- 0	"

NOTES 16:11: 1962=101 @ Operation temp.

YETEM COIL TO MAINTAIN 60%.

				•			<b>B</b> ELUMMUS	- Well Charles Company
<u> </u>	r						THE JET FUEL PI QUERT AMECO/DEL M	ROTS CT MATION REGILAH, ND MMO 055 71
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	1114	Fee TAIR4	SK				PROCESS	ESSEL SKETCH
nev	¥.	DESCRIPTION	70L	70	****	****	VEMEL NO FR- 905	(MC (K) -

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NOTES LTG 576-R = 0.46 @ operating temp	

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						WILL JET FUEL P	MOTECT LOCATION REVIAM, ND		
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PRESSURE TAP (PT)

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TEMPERATURE MOIGATOR (TR)
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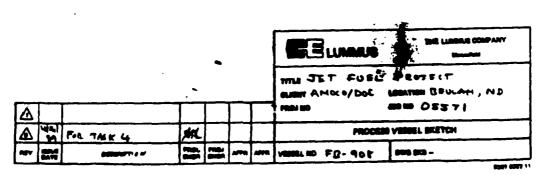
\_ MAN / M

GAUGE GLASS (C)

GAUGE GLASS (C)

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3) STEAM COIL TO HAINTAIN 100"F TEMP



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<u>"</u> = =	TEF. US OPAWOFF TO
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77	DRAIN BAMPLE CONN IS. COOLER ISO
<b>n</b>	BAFETY VALVE IPSV
»	BAPET VALVE PYSVI (ISV) UTILITY COMMECTION
<b>36</b>	PRESSURE GAGE PG
×	PRESSURE CONTROLLER (PC) PRESSURE TAP (PT)
* <u> </u>	£2
41	TEMPERATURE CONTROLLER IT
4	TEMPERATURE RECORDER (TR)
44 1 4	TEMPERATURE WELL (TW)
<b>6</b>	GAUGE GLABS (CG)
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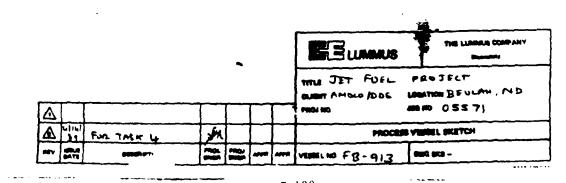
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FIRM MO SIZE SERVICE & STABOL  FIRM MO SIZE SERVICE & STABOL  FILL S	3'-0'

						THE JET FUEL PROTECT GRUEN, NO.		
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A	पान	FUR TMY 4	4				PROCES	VINEL SICETCH
	===	(Management)	=	=	***		VENEL NO FB-911	em tra -

WESSEL NO FB-912 COMB WITH  WESSEL NAME THEF-(8F2) PE32-("MODIA STORAL" E  RAMETYRA 14-0 NA BUSHT  BAS  WESSEL LINETTH  ONE  WESSEL  WESSE	
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VERSEL NO F C Q (4) COMP WITH  VERSEL MARKE NO. V. Y.	}
THEN NO BOX BETWEE & STANDOL  NO RECOLOR  1	18'-0"

					· •		
		-			THE LUMINUS THE LABORE COMPANY		
						THE JET FORL PROJECT GLIENT AND CO / DOE LEGATED SPOUND , N.D.	
							PROJECT 400 MO DS\$71
4	A VIN FOR THE W				PROCESS VESSEL SKETCH		
	35	-			*	-	VERSEL NO FB-9/4 DIRE DED -



THE LUMMUS COMPANY
Bioomfield

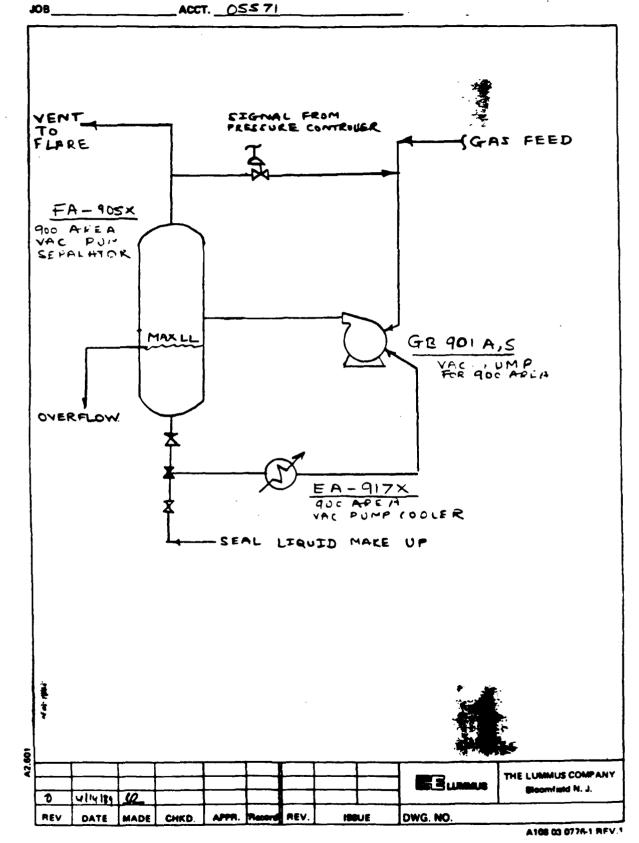
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Div. Job PO/Req. Sup.

DATA SHEET LIGUID RING VACUUM HUMP

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2	FOR AMOLO/DOE - JET				UNIT	<u> </u>	<u> </u>	
3	SITE				DRIVER		3	
	SERVICE VACUUM PUN	+ Fn.	90C F	KEA	NO. REQ	UIRED	<del></del>	
5	MANUFACTURER		MODEL			SERIAL NO	 ).	
6	NOTE O INDICATES INFORMATION TO BE COMPLETED BY PURCHASER D BY MANUFACTURER							
7								
8								
9	(ALL DATA ON PER UNIT BASIS) OTHER CONDITIONS							
10			NORMAL	RATED	A	В	С	RUN-IN
11	GAS HANDLED (Also See Page 2	of 5)		AIR				
12	MMSCFD/SCFM (14.7 pps & 60°F	dry)	I	T	1		T	
13	O WEIGHT FLOW (Ib/min) - (Wet) -	(Dry)	1	3.5	1		]	
14	INLET CONDITIONS:							
15	C PRESSURE (psia)	~	T	1.9	1	1	7	
16	TEMPERATURE (OF)		†	265	1		1	
17	RELATIVE HUMIDITY (%)				1			
18	MOLECULAR WEIGHT (M)			29				
19	ay IPoth Exponent, PTC-10)	7(v		1.29	1			
20	COMPRESSIBILITY (Z1) OR (Zav	a)		1.0		1	T	
21	INLET VOLUME, (cfm.WET)*		1	494	1	1	1	
22	DISCHARGE CONDITIONS:	·		<del>1 \ \ 1</del>	<del></del>	<u> </u>	<del>-</del>	4 <u></u>
23	PRESSURE (psia) *		T	22	T	T	1	T
24	TEMPERATURE (OF)		<del>†                                     </del>	1	<del> </del>	<del> </del>		<del>                                     </del>
25	ng (Peth Exponent, PTC-10)		1	1	1			1
26	COMPRESSIBILITY (Z2) OR (24)	0)	<del> </del>	10	<del>                                     </del>	<del>                                     </del>	<del>†</del>	†
27		<u></u>	<del></del>	<u> </u>				<u> </u>
28	i_, bhp REQUIRED (All Loses Incl.)		T			T		1
29	SPEED (rpm)		1					1
30	PRESSURE RATIO (R)		†	<del> </del>		1	1	1
31	VOLUMETRIC EFFICIENCY (%)			1	1		1	1
32	SILENCER AP (DE) INLET	DISCHARGE	1		1 /	7	1	1
33	PERFORMANCE CURVE NO.		1	1	1		1	
34								
35	METHOD OBYPASS FROM TO OBYPASS OMANUAL OAUTO							
36	SPEED VARIATION FROM TO							
37	OOTHER							
38	SIGNAL O SOURCE							
39	O TYPE							
40	RANGE FOR PNEUMATIC CONTROL 1701 AT 1949 AND 1701 AT 1949							
41 }	OTHER							
. 2							-	
14								
15	:							
16							••	
47	· Ž -							
રહે ં								
1							3	
' ،	· }							
5.7	'AT CUSTOMER CONNECTIONS TO SILENCERS							
i								
53	Propered: Approved:	Det	s: 4/14/74	A Rev. L	$oldsymbol{L}$	Rov. 🛆	Rev.	$\Delta$

PA-901
DESIGN COMPUTATIONS FOR VACUUM PACKAGE FOR 900 AREA



# 6.0 EQUIPMENT DATA AND ESTIMATE SHEETS

6.4 Offsites - AREA 400

# OSBL ESTIMATE

PIPING		
600 TONS X 1.1 FOR FITTINGS & FLAN 2000 GALV. @ \$25/FT LABOR @ .6 HRS/FT. X \$55/HR (8000 TRACING 16200 LF @ \$20/FT		\$1,320,000 \$50,000 \$2,640,000 \$324,000
INSULATION		
FROM BACK UP		\$420,000
PIPERACK		
3000LF @ \$300/FT CONCRETE 1500 Y3 X \$350/		\$900,000 \$525,000
TOTAL INTERCONNECTIONS		\$6,179,000
EQUIPMENT		\$1,846,000
INSTALLATION MATERIALS FOR EQUIPMENT	2 € 25\$	\$461,500
LABOR FOR EQUIPMENT & MATERIALS		\$461,500
	<u>s/t</u>	\$8,948,000
ENGINEERING @ 10 %		\$900,000
	<u>s/t</u>	\$9,848,000
CONTINGENCY @ 30%		\$2,954,400
	TOTAL	\$12,802,400

PIRE	A BOVE GIO	~,D		
1 1/2	35000	1= 3.6 #)	125 126,000 #15	
2	1,000	5.0	55,000	
3	15,000	7.5	112,500	
4	7000	11.0	77200	
8	1000	28.0	28,000	
20	2000	78.0	156,000	
30	2000	118.0 V	236,000 V	
PIZE	BELONG	10.~D		
6	1700	19	32,300	
10	2000	40	80,000	
15	1500	5.	75,000	
26	1500	153	227,500	
	الماري الماري			
	Wegat	10706	1,207,300 Pi,	25 3 1
				<u> </u>
11150	14710~	1/2" 17,	00017 , \$ 10/57	170,000
		2" 6000	, 12	73,000
		3" 8000 4" 400 8" 1000	, 13	10/,000
		400	v 14	56,000
	•	8" 1000	18	18,000
				\$4/20,000

ANCCO/DUE

5571 3/13/89 E.S.

CFFSITES SUMMARY FREA GOO

TASIC 4 DESIGN

FB ITEMS ATTEMED GA ITEUS ATTACHED

NEW RACK 800' 10 ST WIDE DOUBLE TIER 2200' 10 FT WIDE DIUBLE TIER

PIPING		INSUL.	
AZA-	150 ° C.S.		-2x 150 GALV.
1/2"	35,000 =	- ن پي خ	= - 100FT
= "	11,000 FT	6000FT	3"-1000=
3"	15,000 FT	5000	
4"	7,000 =-	inclusion	
§.,	1000 =	1000 7	
20"	Zous FT (B	3,000 54	
"ه ک	2000 FT (3	TH Terces) 2000	

Sewe	-25			<u>=</u>	ETRICAL TEXENS
Z 6 "	745 - 3URIGO	r'	1700 F	2	7000 =-
15"	TSS- BURIED	9'	1500=	· Z "	2600 ==
6"	TGS - BUZIES	91	1500 FT	3"	4300 FT
10"	TSN-BURIES	9'	2000 FT	4"	2300 FT
					-,, 00

ESTIMATE SHEET	SHEET				THE LUMMU	THE LUMMUS COMPANY
	OUANTITY	T INS	MATERIAL	9TO	LABOR MH	SUBCONTRACT
DESCRIPTION	REO EA	COST	COST	UNIT	TOTAL	COST
1	1		_			
2 85'10 40' тт тк sкіятнт			-			
_ ww						
LINING CA 1/8 /		Ø				30400
6 DES PRIESS +5"-2" WG PARE DES TEMP 150 OF						
O DES PRESS hg/cm <sup>2</sup> DES TEMP OC						
7 CAPACITY: 38000 BARRELS/ GALLONS/ M3						
					-	
9 TYPE: CR CSFR ON SPHERE OTHERS HORIZ VERT S						
10 INSUL [] API \$300LLET [] FAB. SHOP [] FIELD \$3	TONS	S				
11 FB 402 STABILIZED NAMTHA	•					
15' 10 40'TT						
		0/	-		_	120,000
14 MAT C. S. CLAD LINING CA 1/8 / mm						_
15 DES PRESS + 5"-2" W & NOWS DES TEMP /50 OF						
16 DES PRESS kg/cm <sup>2</sup> DES TEMP <sup>0</sup> C						
17 CAPACITY: 1200 BARRELS GALLONS M3						
10 INTERNALS						
19 TYPE CH BFR OR OSPHERE OTHERS HORIZ VERT B						
IL   API MOULL	TONS	s    s				
21/18 403 FUEL 0/L						
т тк sкiят нт						
. S. CLAD LINING CA 1/8 /		Ø				472000
+5"-2" WG POUR DESTEMP 150						
kg/cm <sup>2</sup> DES TEMP						
27 CAPACITY: 59,000 BARRELS/ GALLONS/ M <sup>3</sup>						
28 INTERNALS HEATING COLL						
30 INSUL MAPI M BULLET ☐FAB SHOP ☐FIELD M	TOMS	s				
TOTAL THIS PAGE	3					
TOTAL ACCOUNT						
CLIENT HINOCO [DOE GREAT PRAWS GASIF. PLANT PROD FACT	LOC. M.H.	±	, A8	#	EST NO.	5571 ACCT
MOJECT TET FUEL FROM CONT. DEPINED I DUINDE WAGERATE	LAB. COST	150	PATE	3/87		<b>E</b>
					'	

400 AREA	Ą					
ESTIMATE SHEET	неет			THE LUN	THE LUMMUS COMPANY	>
TVI Lei e Sur la la la la la la la la la la la la la	QUANTITY	UNIT	MATERIAL	STD LABOR MH	SUBCONTRACT	¥ç.
	REO EA	COST	COST	UNIT TOTAL	COST	
1 FB 404 LT. ENDS.	/					
20/10 /84TT TK SKIRTHT						
3 m						
AMAT 6 S CLAD LINING CA 1/8   mm						
S DES PRESS + 5" -2 W/G PARC DESTEMP /50 OF						
6 DES PRESS kg/cm² DES TEMP °C		28-			306	000
7 CAPACITY: /OOO BARRELS GALLONS MJ						Γ
BINTERNALS						
9 TYPE: CR KJFR DR SPHERE OTHERS HORIZ VERT K						
10 INSUL   API KIBULLET   FAB-SHOP   FIELD KI	TONS					
11 FB 405 BENZENE PRODUCT						
28						
13 m [] mm []						
14 MAT C.S. CLAD LINING CA 1/8 / mm		120			98/	8
DESTEMP /20						
17 CAPACITY 4500 BARRELS GALLONS M3						
INTERNALS ,						
19 TYPE: CR KIFR LON CISPHERE COTHERS CHORIZ VERT KI						
SBULLET   FAB.SHOP   FI	TONS					
11 FB 406 TOLUENE PRODUCT	/					
11/52 01/27		3			1000	8
23 m   mm						
MAT CS CLAD LINING DCA VB / mm						
25 DES PRESS + 5 -2 WG PSIG DES TEMP / 20 0F						
kg/cm <sup>2</sup> DES TEMP						
27 CAPACITY: /600 BARRELS GALLONS M3						
28 INTERNALS						
29 TYPE: CR KJFR OR OSPHERE OTHERS HORIZ VERT K					===	
30 INSUL API M BULLET FAB SHOP FIELD M ERECT. WT	TONS					
TOTAL THIS PAGE	3					
TOTAL ACCOUNT						
CLIENT AMOCO (DUE-GREAT PLAINS GASIF. PLANT) PROD FACT	LOC. M.H.		84	MAC. 65 JOB NO.	5571	ACCT
BEULAH, NORTH DAKOTH	==	+	DATE	3/89 [53]	T	5. 
1 7	LAB. COST		REV			٦
					730 00000 0000	- 2

	2							[
ESTIMATE SHEET	SHEET					THE LUMMUS COMPANY	AMUS COMPAN Bloomfield	<b>≥</b>
LOWINGS	<b>A</b> ∩O	QUANTITY	UNIT	MATERIAL	STD	STD LABOR MH	SUBCONTRACT	RACT
DESCRIPTION	REO	EA	COST	COST	UNIT	TOTAL	COST	
168 ANT XYLEVE PRODUCT	_							
11, 21 01, 21						-		1
	1					1	7	
MAT 65 CLAD CINING CA 1/8	1		0				1	00
PRICE DESTEMP 120						-		1
kg/cm2 DES TEMP								T
200 BARRELS								
				-				
9 TYPE CRACTED DA SPHERE DOTHERS HORIZ VERT A								
10 INSUL   API MOULLET MEABSHOP   FIELD		TONS						
11 TOS GASOLINE BLEND STORAGE	1					_		
17,10 /8/11								
							-47	
14 MAT CS CLAD LINING CA V8 / mm			200				200	8
PRESS ATMO								1
kg/cm <sup>2</sup> DES TEMP						-		7
630 BARRELS								7
S								
19 TYPE CA BAFA ON SPHERE OTHERS HORIZ VERT B							1	
20 INSUL CAM BOULLET CFAB SHOP CFIELD BO ERECT WT		TONS						
21/18 409 GASOLINE	7					+		
48,10							,	
			0				95	000
MAT C.S. CLAD LINING CA 1/8 / mm								
PRESS ATMOS PSIG DESTEMP 120								
26 DES PRESS Region <sup>2</sup> DES TEMP OC						+		
13000 BARRELS				-		-		
						+		
29 TYPE. CR SOFR ON SPHERE OTHERS HORIZ VERT K								
30 INSUL CAPI BOULLET CFABSHOP CFIELD BY		TONS						
TOTAL THIS PAGE	3				1	+		
TOTAL ACCOUNT			4	+				1554
CLIENT AMOCO (DUE-GREAT PLAINS GASIF. PLANT) PROD FACT		LOC. M.H		A P	\$10	EST NO.	1255	
DAKOTA	+	3		DATE	482		Ţ,	8
PROJECT TET FUEL FROM COAL DERIVED LIQUIDS MAGENAIL		LAB. COST	-	II LE C				1
								:

4 OO AREA	A						
ESTIMALS ESTIMATE SHEET	HEET				THE LUMMUS COMPANY	MMUS COMPAI	<b>À</b>
ĺ	QUANTITY	├	TERIAL	9TD L	STD LABOR MH	SUBCONTRACT	RACT
DESCRIPTION	REO EA	COST C	COST	UNIT	TOTAL	COST	
1 FB 804 TAR PRODUCT	/						
25							
J m		20	L			36	8
AMAT C.S. CLAD LINING CA 14" mm							
Ę							
			_				
2800 BARRELS							
BINTERNALS HEATING COIL							
FR   DOR   SPHERE							
10 INSUL KAPI BOULLET TFABSHOP TFIELD B	TONS						
11 FB BOS PHENOL PRODUCT							
35, 10 35, tt							
14 MAT C.S. CLAD LINING CA 1/8"   mm							
15 DES PRESS +5" - 2" WG BESTEMP /60 OF		20-				3	S
17 CAPACITY: 4600 BARRELS GALLONS M3							
18 INTERNALS HEATING COIL							
Потнея							
20 INSUL SAAM BOULLET TABSHOP TFIELD ST	TONS				.,		
21 F.B.							
22 ID TT TK SKIRT HT							
23 m mm []							
24 MAT CLAD LINING CA							
25 DES PRESS PSIG DES TEMP OF							
26 DES PRESS kg/cm <sup>2</sup> DES TEMP <sup>O</sup> C							
27 CAPACITY: BARRELS/ GALLONS/ M <sup>3</sup>							
26 INTERNALS							
29 TYPE: CR   FR   DM   SPHERE   OTHERS   HORIZ   VERT							
30 INSUL CAPI C BULLET FABSHOP FIELD	TONS						
TOTAL THIS PAGE	2						
TOTAL ACCOUNT							
CLIENT ALMOLO (DUE-GREAT PLANS GASIF. PLANT PROD FACT	LOC. M.H.		¥	~11.7	JOB NO. 5	125	ACCT
DAKOTA DEPLIED LAND	LAB COST	1	DATE	3/82	<b>)</b>	T	£
LUCEL FROM COME DEXIVED LIQUIDA						1	]

						71.15	30000	3
ESTIMATE SHEET	SHEET					Bloomfield	Bloomfield	2
	QUANTITY	٨		MATERIAL	9TD (	9TD LABOR MH	SUBCONTRACT	TRACT
DESCRIPTION	REO E	<		COST	CNIT	TOTAL	COST	<b>-</b>
0-0			_			_		
22,10 24,11								
3 m() mm ()								
AMAT C S CLAD LINING CA			25-				10	58
6 DES PRESS + 5"-2" NG NEE DES TEMP 160 OF						_		
6 DES PRESS kg/cm² DES TEMP OC						_		
7 CAPACITY: 1600 BARRELS GALLONS M3							-	
7100 9						_		
10 INSUL BAPI BBULLET   FABSHOP   FIELD B		TONS						
11 FB 9/2 M/P CRESOL PRODUCT	/					-		
25, 10								
13 mm D mm Ct								
14 MAT 6.5. CLAD LIMING CA 1/8 / mm			25+				53	8
15 DES PRESS + 5" -2" NG + NG DES TEMP /60 OF								
16 DES PRESS kg/cm² DES TEMP °C						_		
17 CAPACITY: 2100 BARRELS GALLONS M3								
5 6016								
19 TYPE CR BER ON SPHERE OTHERS HORIZ VERT 3								
H BOLLET   FAB. SHOP   FIELD S		TONS						
71 FB 913 2,3/2,4 XYLENOL PRODUCT	/							
n /4' 10 /6' тт тк sкінт нт			-05				200	8
MAT C. S. CLAD LINING CA 1/8"   mm								
+5.4-2" WG NESTEMP								
tg/cm <sup>2</sup> DES TEMP								
27 CAPACITY: 440 BARRELS GALLONS M3								
20 INTERNALS HEATING COIL								
29 TYPE: CR SEFR OR SPHERE OTHERS HORIZ VERT S								
30 INSUL BAPI B BULLET FABSHOP PIELO B		TONS						
TOTAL THIS PAGE	3							
TOTAL ACCOUNT								
NOCO IDUE GREAT PLA		LOC. M.H.		λg	K. C.	ON BOY	1255	ACCT
DAKOTA		I AB COST		OATE	3/8/2			62
LAELTKOM CHILDEKINED LIQUIDA				1 75 4				

								ľ
ESTIMATE SHEET	SHEET					THE LUMMU	THE LUMMUS COMPANY  Broanfield	
MONTH OF THE PARTY	۷no	QUANTITY	LINO	MATERIAL	9TD	LABOR MH	SUBCONTRACT	7 =
NOT LEGISLAND	REG	EA	COST	COST	UNIT	TOTAL	COST	
1FB 914 MIXED XYLENOL PRODUCT	/							7
-1								_
								1
AMAT C-S. CLAD LINING CA 1/8 / mm								
6 DES PRESS 5"-2" WG POPE DESTEMP 160 OF			35-				20000	T
6 DES PRESS kg/cm2 DES TEMP °C								T
IRRELS/								_
12								_
빞								$\overline{}$
10 INSUL MAPI MBULLET OF AB SHOP OFIELD M		TONS						т
11 FB								_
12 IO TT TK SKIRTHT								1
13 m m m C m C1								T
14 MAT CLAD CLINING CA mm								1
15 DES PRESS PSIG DES TEMP OF								_
16 DES PRESS kg/cm <sup>2</sup> DES TEMP <sup>O</sup> C								
17 CAPACITY BARRELS GALLONS M3								$\overline{}$
18 INTERNALS								
19 TYPE CR   FR   DR   SPHERE   OTHERS   HORIZ   VERT								
20 INSUL CAPI BULLET CEABSHOP FIELD C		TONS						_
21 FB.								
22 IO IT TK SKIRTHT								_
23 m m m								
24 MAT CLAD LINING CA / mm								
25 DES PRESS PSIG DES TEMP OF								
26 DES PRESS kg/cm² DES TEMP °C								
27 CAPACITY: BARRELS GALLONS M3								
28 INTERNALS								_
78 TYPE. CR   FR   OR   SPHERE   OTHERS   HORIZ   VERT								
30 INSUL [] API [] BULLET [] FAB SHOP [] FIELD [] ERECT WT		TONS						
TOTAL THIS PAGE				_				_
TOTAL ACCOUNT	16							_
OCO DUE-GREAT PLAN	1:	LOC. M.H.		ВУ	*	Son No.	37/ ACCT	
PROJECT TET FUEL FROM CAL DERIVED LIQUIDS WAGERATE	 	LAB. COST	_	DATE	25			
							With a name or t	-

				1	7	AHEA								
	77			ES	ESTIMATE SHEET	SHEE	<b>.</b>					THE LUN	THE LUMMUS COMPANY	ANY
	COME									F			Bloomfield	
		MOITERGOOD				ò	QUANTITY	UNIT	MATERIAL	<u> </u>  }	STDL	LABOR MH	SUBC	SUBCONTRACT
	•	ESCAIL HON				REO	EA	C0S1	COST		₹IN5	TOTAL	ت 	cost
1GA 401/5	77	79R/111	334 7/O	Q'E		2			<u> </u>	=		-		
2 GPM //O	SUCT	PSIG DISCH	15.4 15.4	TEMP	HO09/				25	2000		_		-
3 m3A	SUCT	Aprem 2 DISCH		Locem2 TEMP	ပိ									
SP.GR / O	٥٥	11	12		STGS				-	=			_	
	٥٥	ε	7	hpe.	APM									
6 MAT CASE	55/52	S IMPELLER			0 ± 0									
7 DRIVE EM - XO T	TURB   DIESEL	OTHER		-	¥.				-				-	
1_	RECIP N PROP	ſ	API   ANSI	D is						F		-		
Į.		1								T				
10 INSUL [			ERECT. WT.	WT. PUMP &	& DRIVER		TONS			=			_	
11 GA 402/5	CRUDE	42	PENOL PEE	12		2								
12 GPM 30	SUCT	PSIG DISC	H PSI	TEMP ,	30 07/									
13 m <sup>3</sup> h	SUCT	Rocm? DISCH		NPP TEMP	စီ				15	8	-	-		
14 SP.GR	ΔP	FT	50 181	72	srgs									
15	40	E		horem?	RPM									
16 MAT CASE	6.5	IMPELLER	12 Cr	12	V2HP.	-			-	=	-			
17 DRIVE EM - ST TI	TURB DIESEL D	OTHER			r.v					=				
۱_	RECIP   PROP	1 -	API - ANSI	٥							-	-		
ı		t							-	=		-	-	
20 INSUL X			ERECT. WT. PUMP & DRIVER	UMP & C	RIVER		TONS							
21 GA 403	FUEL	011 7/2	PANSFER			2								
2000 mg 2	suct	PSIG DISCH		TEMP	10 02/	-								
23 m <sup>3</sup> h	SUCT	HOSIG CHOP		Agrem TEMP	ာ				25Tp	500				
28. B.C.	٥٥	FT	5	75	STGS									
ĸ	V	Ε		kg/cm²	MPM				-	=			==	
26 MAT CASE	65	IMPELLER	1201	3	30 HP									
27 DRIVE EM - 🔯 T	TURB   DIESEL	. П отнея [			N. N									
28 TYPE CENT - ES P	RECIP   PROP	П отнеяs П	API ANSI	Ĭ.										
29 MECH. SEAL ES														
30 INSUL			ERECT WT.	WT. PUMP & DRIVER	ANIVER		TONS			=				
TOTAL THIS PAGE						9			-	F				
TOTAL ACCOUNT														
~	DOE-	Fd.	5451F.	PUM	PROD FACT	-	LOC. M.H.	<u> </u>	<u>,</u>	•		LOB NO.	1255	ACCT
PROJECT JET	DEULAH NOK	714 1	DERIVED I DOUBL		WAGE RATE	-	LAB. COST		<u> </u>	DATE REV.	3/2)			<b>≸</b>
			it will	1		-			1				A 1 1 1 0 40 1 10 BEV	D DEV 3

	SLUMMUS			ESTIMATE SHEET	SHEET				THE LUMN	THE LUMMUS COMPANY Bloomfield
					00/	QUANTITY	CNIT	MATERIAL	STD LABOR MH	SUBCONTRAC
	5	DESCRIPTION			REO	FA	COST	COST	UNIT TOTAL	COST
S/404 VS	STABIL.	MACHTHO	TRANS	ANS FER	2					
2 GPM 400	SUCT	PSIG DISCH	PSI TEMP	וחו				2000	2	
W <sub>C</sub> w	SUCT	harema DISCH	spems TEMP	MP OC						
SP.GR	۷۷	FT	50 PSI	STGS						
	40	ε	Pacm2	MAH						
MAT CASE	S	C/ IMPELLER /7	ठे	20 46						
DRIVE EM - XX T	TURB DIESEL	O OTHER		N.N.						
			I D ANSI							
10 INSUL []		83	ERECT WT PUM	WE PUMP & DRIVER		TONS				
11 CA 405/5	CRUPE	MACHIN	FEED		7					
12 CPM 25	Suct	PSIG DISCH	PSI TEMP	MP /00 OF				15boc	<u> </u>	
13 m <sup>3</sup> /h	SUCT	Aprem 2 DISCH	MOCENT TEMP	Ω <sub>0</sub> dγ						
14 SP GR 0.7/	ΔP	FT	S0 PS1	STGS						
	ΔP	E	hpa hg/cm2	RPM						
MAT CASE		IMPELLER		1.5HP						
DRIVE EM - T	TURB   DIESEL	О отнея □		kW.						
18 TYPE CENT -[] F	RECIP   PROP	OTHERS   API	□ ANS!							-
MECH SEAL							-			
20 INSUL 🗌		ERE	ERECT, WT PUMP & DRIVER	& DRIVER		TONS				
3/904 vo 11	5A506111E	SHEMDINS	2 yous	RAWS.	7					
27 cm 75	SUCT	PSIG DISCH	PSI TEMP	100				15000	9	
w <sub>2</sub> w	SUCT	Agems DISCH	Agrem 1 TEMP	OO JW						
SP.CR 0, 89	Δ۶	FT	50 PSI	STGS						
	Qε	E	hPb hg/cm <sup>2</sup>	HPM						
MAT CASE	6.5	IMPELLER /2	2 C F	3 HP.						
27 DRIVE EM - SO T	TURB C DIESEL C	🗆 отнея 🗀		**						
28 TYPE CENT - [3]	RECIP   PROP	OTHERS	API   ANSI							
29 MECH SEAL B										
30 INSUL [		ER	ERECT, WT. PUMP & DRIVER	& DRIVER		TONS				
TOTAL THIS PAGE					9					
TOTAL ACCOUNT										
CLIENT A11/0CO	0/DOE-6/REAT	PLA	ASIF. PUMM	PROD FACT	- 15	LOC. M.H.		À	ON 807 177	5571 Acct
LOCATION BE			A		+		-	DAT	3/82	KA   CA
PROJECT JET FUEL		FROM COAL DERIN	DCRIVED LAWIS WAGE RATE	MAGE HA	_	LAB. COST	_	MEV.	,	

1	Control   Con		3									35	1000
1	10   10   10   10   10   10   10   10		250	CHIPTION			3	ANTITY	INI	MATERIAL		- 1	Jurielo
	1			;			REO	EA	COST	COST		LABOR WH	SUBCONTRA
	CASE   SUCT   WIND	1702	BENZ	. [		7	7				25	LOTAL	1893
10	10	007	SUCT	PSIG DISCH		00/				_		+	
CASE   CS	CASE   C.S	W-W	sucr	ADISCH DISCH	hPa Aprem2					_			-
CASE   CAS     WILLIAM   12 C/F   10 HP	CASE   CAS	SP.CH 0.89	Q.	FT	50 8						1		
CASE   C   S	CASE   CAS		0	E							1		
10   10   10   10   10   10   10   10		MAT CASE	S	IMPELLER	1	10				1	1	-	
E CENT — G RECT PROP ☐ OTHERS ☐ ANS ☐  19 SA G	CASE   Start    DRIVE EM - X TUR		J		1				+				
H   SEAL     S   C   C   C   C   C   C   C   C	H   SAL     S   S   S   S   S   S   S   S   S		_	OTHERS	1	  -							
10	CASE   SUCT   FREET WIT PUMP & DRIVER   TOWN & DRIVER   TOWN & DRIVER   TOWN & DRIVER   TOWN & DRIVER   TOWN & DRIVER   TOWN & DRIVER   TOWN & TOWN	SEAL E			ſ	]						1	
150   Suct   Price   Discrete   Price   Price   Discrete   D	S   Suct   Psic   Trap   Step   Ste	INGUL []			FRECT WIT P	MAP & Opius							
150   Suct   Pesic   Disch   Legal   String   Oct     150   Suct   Pesic   Disch   Legal   String   Oct     150   Suct   Legal   Disch   Legal   String   Oct     150   Suct   Legal   Disch   Legal   Disch   Legal   String     150   Cent	150   Suct   Fisc   Disch   120	CA 40 8/5	TOLUE	101	V-VI JIK	a China	1	LONS			1		
S   SUCT	Suct	150	UCT	Disci	/		J			_			
A	CASE			PP 3 DISCH			1			$\Box$			
CASE   CS	CASE   C_S   IMPELIER   Z C V   Z V V V V V V V V V V V V V V V V V	2		FT FT	, 40,0		1						
CENT CASE C S	CENT — SA TUNB — DIESEL — OTHER — NEET WIT PUMP & DRIVER — TONS  CENT — SA RECIP — PROP — OTHER — API — ANSI — NEET WIT PUMP & DRIVER — TONS  LOST — SA LEA — NEET WIT PUMP & DRIVER — TONS  SEAL EX SUCT — NEET NEET NEET NEET NEET NEET NEET N				0								
CEM -   Struck   Diese   Others   Oth	CEMI -   C	MAT CASE		E		-							
CENT - SI NOHED   DIESEL   OTHERS   AND   ANS	CENT - SI PICHE   DIESEL   OTHER   DINS   DINS	1			니								
SEAL	15 Suct Recip   Prop   Others   April   Ansi      16 3 / S	- 1	DIESEL	OTHER [		W							
1 SEAL W.   SHEET WITHOUM & DRIVER   TONS	## 100 FEET WIT PUMP & DRIVER TONS    1	٦.	PROP	1	- 1								
## 100 State   Freel wt Pump & Driver   100 State   10	Case   Sauct   Price   Discrete   TRANSFER   Case   Sauct   Price   Discrete   Case	MECH SEAL K											
S   Suct   Price   Olsch   O	S   SUCT   PSIG   OISCH   PSI   TEMP   OCO   P   SUCT   PSIG   OISCH   PSI   TEMP   OCO   P   SUCT   PSIG   OISCH   PSI   TEMP   OCO   P   SUCT   PSIG   OISCH   O				RECT. WT. PUR	AP & DRIVER	_	TONS					
Sinct   Fig Oisch   Fig   Temp   Oo of	Suct   Psic Disch   Psi   Temp   Oco of suct   Psic Disch   Psic Di	102/5	TENE	3	FER		2				1		1
SUCT   LOCATE   LOC	SUCT   1,000   TEMP   OC	52		PSIG DISCH	. –	_	-				†		
Or   FT   SO PSI   STGS	Or   FT   SO PSI   STGS			MOCE DISCH	100cm2 T	1	+		1	щ.			
OF	Or   Marciler   12 CF   LS HP	. 88		FT		STGS	-						
TUNB DIESEL OTHER ANSI ANSI ANSI ANSI ANSI ANSI ANSI ANSI	TUNB DIESEL DOTHER DANSI AND BE DRIVER  CONDET GREAT PLAIM GASIF PUMP & DRIVER  TONS  TONS  CONDET GREAT PLAIM GASIF PUMP & DRIVER  TONS  CONDET GREAT PLAIM GASIF PUMP & DRIVER  TONS  CONDET GREAT DANS GASIF PUMP & DATE TYPE  FUEL FROIL CAL DCRIVED LAUIS MAGERATE  TONS  CONDET TYPE  TONS  RECTP TONS  FOR MAGERATE  TONS  RECTP TONS  FOR MAGERATE  TONS  RECTP TONS			E	hpe halom2								-
TUNB DIESEL DOTHER ANSI ANSI ANSI ANSI ANSI ANSI ANSI ANSI	TUNB DESEL DOTHERS API ANSI ANSI ANSI ANSI ANSI ANSI ANSI ANS			`	3	> /	+		1				
GE  CO/DOE-GREAT PLAINS GASIF. PLAIN PROD. FACT  COMM.  BY MET ET 108 NO. 5571  BY MET ET 108 NO. 5571  CAUCH A COLUMN CALUE LANGERATE  CAUCH PLAINS GASIF. PLAINS WAGERATE  CAUCH PLAINS WAGERATE  CAUCH PLAINS GASIF. PLAINS WAGERATE  CAUCH PLAINS GASIF. PLAINS WAGERATE  CAUCH PLAINS GASIF. PLAINS WAGERATE  CAUCH PLAINS GASIF. PLAINS WAGERATE  CAUCH PLAINS	THECIP PROP OTHERS API ANSI ANSI ANSI ANSI ANSI ANSI ERECT WT. PUMP & DRIVER  OO DOE - GREAT PLAIM GASIF. PLAIM PROD FACT  FUEL AH A NORTH DAR ATA  FUEL FROIL COAL DCRIVED LAUIS WAGERATE  LAB. COST  RES  TONS  BY MELET 108 NO.  BY MELET 108 NO.  RES  TONS  TONS  RES  TONS  TONS  TONS  RES  TONS		DIESEL	_		N.	+		+				
GE CO/DOE-GREAT PLAINS GASIF. PLAIN PROD FACT FUEL FRUIT GALDCRIVED LAWING WAGERATE LAB COST REV.	GE CO/DOE-GREAT PLAIM GASIF. PLAIM PROD FACT LOC.M.H.  FUEL FRONT COAL DCRIVED LOUIS WAGERATE LAB. COST REV.	- 1	PROP	1	1		+		+		+		
HIS PAGE CCOUNT  HIS PAGE CCOUNT  HIDOCO/DOE-GREAT PLAINS GASIF PLAIN PROD FACT  HIDOCO/DOE-GREAT PLAINS GASIF PLAIN PROD FACT  HIDOCO/DOE-GREAT BY MAZE FILD LOC.M.H.  BY MAZE ET 10B NO. 5571  DATE IND. 5571  HEY.	HIS PAGE CCOUNT  HIS PAGE CCOUNT  HIDOCO/DOE-GREAT PLAIM GASIF. PUM PROD FACT  HIDOCO/DOE-GREAT PLAIM GASIF. PUM PROD FACT  HIDOCO/DOE-GREAT BY ARGENTE  HIDOCO/DOE-GREAT BY ARGENTE  LOC M.H.  BY MED ET LOC	MECH SEAL []		1	1		+		+		+		-
PLAINS GASIF. PLAIN PROD. FACT LOC.M.H. BY MAY ET NOB NO. 5571  9.4 DAK 677A DALOUIS WAGERATE LAB. COST REV.	PLAINS GASIF PHIM PROD FACT LOCMH. BY MAY ET NO OATE YES EST NO OATE YES EST NO	INSUL []		ER	TECT WT PUM	P & DRIVER	+	TOME	+	+			
PLAINS GASIF. PLAIN MOD FACT LOC.M.H. BY MAZE EST NO. 5571  9AL DCRIVED LAULD WAGERATE LAB. COST REV.	PLAINS GASIF. PLAIN PROD FACT LOC.M.H. BY MAY ET JOB NO.	TOTAL THIS PAGE					+		+				
PLAINS GASIF, PLAIN MOD FACT LOC.M.H. BY MET ET JOB NO. 5571  OAL DCRIVED LAULD WAGERATE LAB. COST REV.	PLAWS GASIF. PLAM PROD FACT LOC.M.H. BY MAY ET JOB NO. OAL DCRIVED LAWIS WAGERATE LAB. COST REV.	TOTAL ACCOUNT					e		+				
4 DAKOTA MAGERATE LOC.M.H. BY MATE ET 108 NO. 5571	4 24 K OTA WAGE RATE LAB. COST REV. REV.	CLIENT AMOCO/U	DE-6/2E47	DIAME	ASIE DIA	<u> </u>	}	    -  -					
FRUIT COAL DERIVED LAULD WAGE RATE LAB. COST REV.	FRUIT COAL DERIVED LADUIDS WAGE RATE LAB. COST REV.	LOCATION BEUL,	1H, NORT	746	2		_	LOC. M.H.		٦,	- 17	2	一
		PROJECT JET FUE		J 1	VED LAWIT	_		LAB. COST		REV	7.55		Т

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P-8 TRAMS FEACE	E E LUMMUS	MUS			ESTIMATE SHEET	SHEET					THE LUMMI	THE LUMMUS COMPANY	>
10   10   10   10   10   10   10   10						à	INTITY	UNIT	MATERIAL	STD	LABOR MH	SUBCONTE	Ž
Co   100		DES	SCRIPTION			REO	EA	COST	COST	TINO	TOTAL	COST	
	GA 410/	JP-8	3	ER		4			-			-  -	
Section   Sect	GPM	SUCT	PSIG DISCH						_				
MAT CASE    A		SUCT	horem? DISCH										
MAT CASE	•	40	FT	n.	STGS								
March   Section   Coloration	9	۵۶	E	hg/cm									
Trie Carl   Street   Other	MAT	57	IMPELLER	CF	50								
The Critical Prop   Others   Art   Area   Others   Art   Area   Art   Area   Others   Art   Area	🛛 – МЭ ЭЛІНО	1 . 1	_		kW								
NEGOL	TYPE CENT - M		ļ	1_									
Can 41													
CON 411/5 \$495 0 LIVE 70PMJ FCAC  CON 440 STATE STORE  CON 440 STATE STORE  CON 5.44 \$\langle \text{Stote} \	O INSUL []			RECT WT	JMP & DRIVER		TONS						
Suct	411/	5450CIV				2							
Succion   Suc	4	suct	PSIG	PSI	3				2000				
SP GR 0.74   DP	3 m <sup>3</sup> m	SUCT	hgem? DISCH	1,Pa2									
MAT CASE  C S INVELLER / Z C H P.  DORIVE EM - B TURB □ DIESEL □ OTHER □ OTHE		ΔP	11	0	STGS								
NECH SEAL OF THERE OF SELEN / 2C HP  TYPE CENT - BATE OF SELEN / 2C HP  MECH SEAL BATE OF SELEN OTHERS OF SELEN OTHERS OF SELEN AND SELEN OF SELEN AND SELEN OTHERS OF SELEN AND SELEN OTHERS OF SELEN AND SELEN OTHERS OF SELEN AND SELEN OTHERS OF SELEN AND SELEN OTHERS OF SELEN AND SELEN ACCOUNTS SELEN AND		٥٥	E	1P.									
NHECH SEAL S  NHECH S  NHECH S	6 MAT CASE	CS	IMPELLER /	1	20								
NECH SEAL   SAID   NUMBER   ANSIL	1												
NECH. SEAL   SA   SUCT   PSIG   DISCH   PSI   TEMP   OF   SPICE   MASUL   M		ECIP   PROP	OTHERS []										
COM SUCT PSIG DISCH PSI TEMP OF STORM SUCT NUMB & DRIVER CONT. SUCT PSIG DISCH PSI TEMP OF STORM SUCT NUMB & DRIVER CONT. SEAL STORM STOR	MECH SEAL ES												
Com    2	O INSUL				MP & DRIVER		TONS						
GPM         SUCT         PSIG DISCH         PSIG DISCH         FSI TEMP         OF         PSIG DISCH         FEMP         OF         PSIG DISCH         FEMP         OF         PSIG DISCH	11 GA					2							
## SUCT    1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0	Z GPM	SUCT	PSIG DISCH	i Sa							-		
AP   FT   PSI   STGS   PSI	a m³€m	SUCT	HOSIO 2004										
MAT CASE  MAT C	M SP.GR	Δr	FT	PSI									
MAT CASE  MAT CASE  ORIVE EM.— TUMB   DIESEL   OTHER   L.O. M.H.  ORIVE EM.— TUMB   DIESEL   OTHER   L.O. M.H.  MECH. SEAL   L.O. M.H.  INSUL   L.O. M.H.  CLIENT #///OCO/DOE-GREAT PLAIN GASIF. PLAIN PROD. FACT  LOCATION BEULAH, AURTH DAKATA  FROME CTIENT #///OCO / DOE /	<b>S</b> 2	۵۴	£	horm horm									
ORIVE EM - TUMB DIESEL OTHERS API ANSI ANSI ANSI ANSI ANSI ANSI ANSI ANS	6 MAT CASE		IMPELLER		H.P.								
NECH SEAL ☐  NECH	ORIVE EM -				rw.								
ERECT WT. PUMP & DRIVER   TONS   DONE	TYPE CENT -	ECIP   PROP	отнеяѕ□										
PAGE  DUNT  100.00/DOE-GREAT PLAINS GASIF. PLAIN PROD.FACT  BEULAH, AUGRIN CARL DERIVEY LOUIS WAGERATE  THE LAB. COST  REV.	MECH SEAL												
OLDGE-GREAT PLAINS GASIF. PLAIN PROD. FACT LOC.M.H. BY HZ EST NO. 5571  OLDAH, ALORTH DAK GTA  EVEL FRUIT COAL DERIVED LAGURS WAGERATE LAB. COST REV.	O INSUL []				MP & DRIVER		TONS						
-GREAT PLAINS GASIF. PLAIN PROD. FACT LOC.M.H. BY 122 EST NO. 5571 LAUGZTH CHARATA WAGENATE LAB. COST REV.	TOTAL THIS PAGE					e							
-GREAT PLAINS GASIF. PLAIN PROD. FACT LOC. M.H. BY HAZ ES LOB NO. 5571  A LORING COAL DERIVED LOGUES WAGERATE LAB. COST REV.	TOTAL ACCOUNT												
- NURTH DAKUTA DAING WAGE HATE LAB. COST REV. 3/85 ESI - 11	CLIENT AU/OCO	DOE-GRE	AT PLAINS		-	15	LOC. M.H.		9	J	100 NO	7,	CCT
WAGE RATE LAB. COST	LOCATION BEC	JUNA I NOX	STH CHK	977A		+		+	DATE	$\sim$		T	₹5
	PROJECT JET F	VEC FROM	COAL DER	WED LAW	_	2	LAB. COST		REV.				

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E E LUMMUS	AMUS			ESTIMATE SHEET	SHEE	_				THE LUMMUS COMPANY Bloomfield	MMUS COMPAN	<u> </u>
		NOIZE BOSSO			OO	OUANTITY	UNIT	MATERIAL	STD	LABOR MH	SUBCONTRACI	RACT
,	5	NOT LIVE			REO	€A	COST	COST	†₩5	TOTAL	COST	
16A 413/5	300-	LT ENDS	5 TRAINS	アピア	7							T
2 GPM /00	suct	PSIG DISCH	PSI	TEMP /20 OF				15,000				
3 m3h	SUCT	Apr. DISCH	hpe. TE	TEMP OC				•				
86.0 BD 48	₽	11	50 181	STGS								
9	ΔP	E	hPe.	MPM								
6 MAT CASE	6.5	IMPELLER /	12CF	S HP.	,							
7 DRIVE EM - KA T	TUMB DIESEL	O OTHER		r w								
<u></u>		1	API   ANSI									Γ
	1	l			-							
10 INSUL P			ERECT WT PUMP & DRIVER	AP & DRIVER		TONS				-		
11 GA 414/5	798	PRODUCT	T TRAINSFIE	Fire	4							
12 GPM 200	SUCT	PSIG DISCH		TEMP /60°F				2000				
13 m <sup>3</sup> /m	SUCT	hgem 2 DISCH	agicm2 TEMP	NP oc								
14 SP.CR / 08	40	FT	IS4	STGS								
16	Vδ	E	hPa 5	MAH								
16 MAT CASE	5.5	IMPELLER	1200	4H 5/								
T DRIVE EM - TH	TURB DIESEL	□ отнея 🗆		MY								
18 TYPE CENT -   P	RECIP   PROP	OTHERS X	AP!   ANS!									
19 MECH SEAL												
20 INSUL 🔯			ERECT WT. PUMP & DRIVER	P & DRIVER		TONS						
21 CA 415/5	PHENOL		PRADUCT 7	TRANS.	7							Γ
72 GPM 200	SUCT	PSIG DISCH	-	TEMP /60 0F		1		15000				
23 m <sup>3</sup> /m	SUCT	ADSIO CHO	Agrem 2 TE	TEMP °C								
34 SPGR /. 08	Δ.	FT	50 MsI	STGS								
R	V	E	hpa hg/cm2	MAH								
26 MAT CASE	52	IMPELLER	12cr	/O HP								
27 ORIVE EM - ST TURB	URB D DIESEL	□ отнев □		MY								
TYPE CENT - [X]	RECIP   PROP	] отнеяѕ□	API   ANSI									
TO MECH. SEAL (X)			;								·	
30 INSUL 🔯	i		ERECT WT PUM	WT. PUMP & DRIVER		TONS						
TOTAL THIS PAGE					9							
TOTAL ACCOUNT												
-3	DOE-578	Pull	GASIF. PUM	PROD. FACT	<del>.</del>	LOC. M.H.		87	WE	S LOB NO.	1255	Acct
PROJECT TET	DEULAH JAOKIH FT FUEL FROM CO	77 400	CRIVED LAWIN	WAGE RATE	<u> </u>	LAB. COST	_	BEV.	\$\frac{1}{2}			<u>₹</u>
					}							]

				400 A	AREA			-		,	
	STAMMUS			ESTIMATE SHEET	SHEE	_			Ē	THE LUMMUS COMPANY	COMPANY
					ğ	DUANTITY	LINO	MATERIAL	STD LABOR MH		SUBCONTRAC
		DESCRIPTION			REG	EA	COST	COST	UNIT	TOTAL	COST
16A 416/5	٥	O-CRESOL	TRANS		٦						_
2 cm 150	SUCT	PSIG DISCH		TEMP / 20 OF				15000			
J m <sup>3</sup> A	SUCT	harem2 DISCH	bpa bpcm2	TEMP OC							
4 SP.CR 0.98	4V &	14	50 13	STGS			·				
•		E	hpe.	HPM 5							
6 MAT CASE	S	IMPELLER	12cr	7/2 40							
7 DRIVE EM - S	TURB D	DIESEL OTHER		N.				 			
-		OTHERS	API [] ANSI								-
9 MECH SEAL ST	1										
10 INSUL (X			FRECT WT P	ERECT WT PUMP & DRIVER		TONS					
11 CA 417/5	d/M	CRESOL	TRANS		4			-			
12 GPM 200	SUCT	PSIG DISCH	P.S.	TEMP / 20 OF				15/200			
13 m <sup>3</sup> /h	SUCT	PP&7 DISCH	hocm2 TEMP	LEMP OC							
14 SPGR 1. 035	1 De	FT	50 PS	STGS							
15	۵r	ш	4.0km <sup>2</sup>	Mat 2							
16 MAT CASE	6.5	IMPELLER	1201	10 46							
17 DRIVE EM - KI TURB DIESEL [	TURB   DIE	ESEL OTHER D		M4							
18 TYPE CENT - S	RECIP 🗌	PROP OTHERS A	API 🗌 ANSI	)							
19 MECH SEAL R											
20 INSULED			RECT. WT. PU	ERECT. WT. PUMP & DRIVER		TONS					
21 GA 4/8/5	4/2/8/2	4 CRESOL 1	LANSFER	EK	7			$\frac{\infty}{2}$			
nam 50	SUCT	PSIG DISCH	Ē	TEMP /200 PF	-						
23 m <sup>3</sup> h	SUCT	hacma DISCH	hPe hg/cm <sup>2</sup>	O GWELL							
M SP.CR 0.97	40	F1	50 181	STGS							
25	Δε	E	hPa hQrcm2								
26 MAT CASE	<b>CS</b>	IMPELLER	12cr	2/248							
27 DRIVE EM - X TURE		DIESEL OTHER		MN							
28 TYPE CENT -X	RECIP	PROP   OTHERS	API   ANSI								
29 MECH SEALED											
30 INSUL ED		3	RECT WT. PU	ERECT WT. PUMP & DRIVER		TONS					
TOTAL THIS PAGE					J						
TOTAL ACCOUNT											
CLIENT AMOCO		DOE-GREAT PLAINS GASIF	. 1	PUHAT PROD FACT	11	LOC. M.H.		ВУ	MI ES K	2	567, ACCT
LOCATION BL	~	1	ZA.					DATE	3/87	ESI	SA CANA
PROJECT JET FUEL	-	FROM COME DER	IVED LADO	DCRIVED LAWID WAGE HATE		LAB. COST		ne v.			

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10   10   10   10   10   10   10   10					ESTIMATE SHEET	SHEE	_				Bisomfeld	Bloomfeld
4/9						8	ANTITY	UNIT	MATERIAL	STD		SUBCONTRA
10   10   10   10   10   10   10   10		Ö	SCRIPTION			REO	ÉA	COST	COST	†ıw∩	TOTAL	COST
100   Suct   Psic   Disce   Psi   Teap   Ordinary   Psi   Teap   Ordinary	1	MIXED	XYLE	- TR.	2/7.	7			1500			
CASE   SUCT   WEELER   7 C o F H   1		SUCT	1		021				-			
O - 9/4   Ob		SUCT	Agrem 2 DISCH		}						-	
A	SP.CR 0.91	٥٥	£1	Ó								
Suct		Φ.	E	Ag/cm								
SUCT	MAT CASE		IMPELLER	3	ľ							
Stort	DRIVE EM - M TI	JAR DIESEL	1		W.W.							
Suct   PSIC   DISCH   PSI   TEMP   Or	TYPE CENT - M	LECIP   PROP	OTHERS [	i i	()							
				l.								
Suct FSIG   OISCH PSI   TEMP OF	INSUL []		<b>1</b>	ž	IMP & DRIVER		TONS					
Suct	₹9											
SUCT	GPM	SUCT	PSIG DISCH		<u> </u>   							
CLASE	m <sup>3</sup> /h	SUCT	horem? DISCH	borm?								
CASE	SP GR	٥٥	=	PSI	SrGS							
VE ENT -   TURB   DIESEL   OTHERS   API   ANSI   LOSS  H SEAL   LOSS   LOST   CONFERS   API   ANSI   LOSS    H SEAL   LOSS   CONFERS   API   ANSI   LOSS    N SUCT   VOCATION   VOCATION   VOCATION   API   LOSS    N SUCT   VOCATION   API   API   API   API    N SUCT   VOCATION   API   API   API   API    N SUCT   VOCATION   API   API   API    N SUCT   VOCATION   API   API   API   API    N SUCT   VOCATION   API   API   API    N SUCT   API   API   API   API   API   API    N SUCT   API   API   API   API   API   API    N SUCT   API   API   API   API   API   API   API    N SUCT   API   API   API   API   API   API   API    N SUCT   API   API   API   API   API   API   API    N SUCT   API    N SUCT   API    N SUCT   API   API   API		٥٥	E	mayen Mayen								
VE EM	MAT CASE		IMPELLER									
F CENT -   RECIP   PROP   OTHERS   ANSI     ANSI	0	1	_		kW.							-
H SEAL []		-	отнеяs 🗀									
SUCT   PSIG   DISCH   Laboratory   TEMP   O	<u> </u>	1 1							-			-
SUCT   PSIG   DISCH   PSI   TEMP   OF	INSUL		E H	ž	WP & DRIVER		TONS					<del> </del>
Suct	₽											-
### SUCT	CPM	SUCT	PSIG DISCH	īS.								
APC   APC	m <sup>3</sup> /m	SUCT	hacma DISCH	kp/cm2								
MAT CASE  MAT CASE  IMPELLER  DRIVE EM. ☐ TURB ☐ DIESEL ☐ OTHERS ☐ APIN   HP  TYPE CENT — ☐ TURB ☐ DIESEL ☐ OTHERS ☐ APIN   APIN & DRIVER ☐ ANSI ☐ A	SP CF	Δ۴	FT	PSI								
MAT CASE  MAT CASE  DRIVE EM - TUMB   DIESEL   OTHER    TYPE CENT - TUMB   DIESEL   OTHER    MECH SEAL    MEC		Δ¢	E	a Pa Agicen								
TURB DESEL OTHERS API ANSI ANSI ARCIP PROPE OTHERS API ANSI ANSI ANSI ARCIP TONS  GE  V.  CO/DOE-GREAT PLAINT GASIF. PLAIN PROD FACT  SECULAH, NORTH ARCHAR MAGERATE  LAB COST  REV.	MAT CASE		IMPELLER		ă Ŧ							
GE  V. CO DOE - GREAT PLAINT GASIF. PLAIN PROD FACT  SECULAH, NORTH DAKOTA  SECULAH, NORTH DAKOTA  WAGERATE  LAB COST  REV.		URB 🗌 DIESEL (	] отнея 🛚		W.							1
NECH SEAL [] INSUL [] TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT #///OCO/DOE-GREAT PLAINS GASIF PLAIN PROD FACT  LOCATION BEULAH, NORTH AAKOTA  LOCATION BEULAH, NORTH AACTA  LOCATION BEULAH, NORTH AAKOTA	_		OTHERS	- 1					_		-	
TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL THIS PAGE  TOTAL ACCOUNT  CLIENT ### (= 5 Mg No 557)  LOCATION BEULAH, NORTH ARAGEMENTE LAB. COST  LOCATION BEULAH, NORTH ARAGEMENTE LAB. COST  HEV.												
CCOUNT CC	INSUL []		13		MP & DRIVER		TONS					
1 NORTH DARWE GASTE PLAIM PRODERACT LOC. M.H. BY THE GEST NO. 5571	TOTAL THIS PAGE					7						
4 NORTH DAKOTA MAGERATE LAB COST REY STATE 185 NO. 5571	TOTAL ACCOUNT										-	1
FOUNT COLD DESTINATION WAGE RATE LAB COST REV.	CLIENT AILOCA		AT PLAWS		$\leftarrow$	Į,	LOC. M.H.		₩ 1	***	EST NO.	1/2
	LOCATION DE	~	<b>₹</b>			IE	LAB COS	1	REV	7	7	

# APPENDIX G

Letter from D. P. Daley to J. G. Masin, March 3, 1989.
"GPGP By-product Marketing Assessment"



# Burns and Roe Services Corporation

P.O. Box 18288, Pittsburgh, PA 15236 • 412-892-4701

March 3, 1989 DPD-89-154

Mr. J. G. Masin Amoco Oil Company Research and Development Department P.O. Box 400 Naperville, Illinois 60566

Subject: Contract No. DE-AC22-87PC79338

Subtask 3.03

GPGP By-Product Marketing Assessment

Dear Mr. Masin:

In response to your request for recent market information on the GPGP byproducts, attached please find a Market Assessment performed by Stanford International for Fluor. This assessment was presented in Fluor's January 1989 report to the U.S. DOE entitled "Great Plains Coal Gasification Plant - By-Products Development Program Summary Report".

If you have any questions, please contact S.N. Rao at (412) 892-4716 or R.J. Rossi at (412) 892-4845.

Very truly yours,

tonald P. Daley

Donald P. Daley Project Director

RR/jm

Attachment

cc: R. Carabetta

G. McGurl w/attachment

J. Parise (2)

G. Reule

G. Stiegel w/attachment P. LaRosa w/attachment ?

S.N. Rao w/attachment

R. Rossi w/attachment

W. Harrison (USAF) w/attachment A. Kuhn (DGC) w/attachment

# 2.2 Task #2 - Market Assessment

# 2.2.1 Objective

The objective of this task was to obtain from an independent source a comprehensive market analysis to help determine the most promising by-products for development and marketing and to prioritize the development and marketing among the by-products. The marketing analysis was executed by Stanford International (SI) of Menlo Park, California (formerly called Stanford Research Institute).

## 2.2.2 Scope

The scope of the study was as follows:

- 1. Assessment of markets
- 2. Exploration of pricing criteria for products
- 3. Matching products with markets.

Each of these items is discussed below.

The market assessment was based on consideration of the following market considerations:

- Supply and demand evaluation of domestic and where applicable foreign markets.
- An analysis of the production capacity by domestic and foreign producers.
- Evaluation of imports and exports, trade limitations and transportation issues.
- Survey of announced and potential manufacturing expansions.
- Projections of the impact of new technologies, new products, and existing commodity replacements.

For all of the above considerations historical and forecast information was used. SI is continuously updating a series of books for various chemicals and commercial gas. Input was received from the proprietary background information

Rather than relying on historical data for price projections, the scope of the project was aimed at exploring pricing criteria for the various products and then projecting future pricing and trends based on these criteria. The basic presumption was that prices are market driven; that is, the price of a product is solely a function of basic market elements and is not affected by political pressures, foreign cartels, trade sanctions or other undeterminate events.

The potential by-products had to be evaluated in view of existing, competitive products, therefore, the scope of the task included matching the volume and quality of the potential by-products with those currently marketed. DGC provided SI with anticipated volumes, composition and quality of the potential products.

044/10007/011

# 2.2.3 Technical Approach

SI's technical approach to execution of the task was based on:

- Contacting suppliers and product users
- Using published surveys and trade journals
- Using SI's own nonproprietary data base

Primary information was obtained by contacting individual suppliers and users of the respective products under evaluation. Nonproprietary and proprietary information thus collected was evaluated and compared. The requested information focused on the three main elements of the work scope, namely: assessing the market, exploring pricing and required product quality. Also, inquiries were made about projected expansion or termination of current production. Product users were also queried whether or not a coal derived product would be acceptable for their raw material purchases.

Published literature was another source of information. Because the depth of the study was limited, information on foreign markets and price trends was mostly obtained from available publications.

In executing the project, SI also relied on its applicable proprietary data base. SI's data base information complemented and augumented the above mentioned information sources.

#### 2.2.4 Task Description

DGC defined the following product slate for evaluation and provided the potential quantities that could be produced:

	Annual
	Production,
	MM Lbs/Year
Pheno1	37
Ortho cresol	10
Meta-para cresol mix	26.4
mEthyl phenol	
2,3-Xylenol	7.6
p-Ethyl phenol	
3,4-Xylenols	1.7
3,5-Xylenols	3.4
2,4-, 2,5-Xylenol	6.5
Creosote	27
Aromatic naphtha, millions of U.S. gallons/yr	10
Carbon dioxide, million standard cubic feet/day	180
Argon, thousands of short tons/yr	34.5
Krypton, Xenon, millions of liters/yr	2.6

Accordingly, SI evaluated each commodity as defined by the objective and scope of the project.

#### 2.2.5 Results and Conclusions

The target markets defined in this section are domestic ones for phenol, aromatics, carbon dioxide and argon. All others include an export component.

#### 2.2.5.1 Phenc1

Projected Production: 37 MM lb/yr Percent of U.S. Capacity (1987): 1.1 Markets Accessible to DGC (1992): 300 MM lb/yr

SI's assessment projects that provided DGC markets specification grade phenol (with no impurities that are characteristics of coal derived phenols) a good market potential exists in the 1990-1995 timeframe. Because no demand decrease is forecast and because synthetic phenol will require a premium price due to firm benzene and propylene prices, one can expect a firm netback value of 45-50 c/lb for phenol. However, because of the cyclical nature of the chemical market, the opportunities should be exploited in the near future to establish a position.

# 2.2.5.2 <u>Cresols</u>

Projected Production
Ortho Cresol 10 MM lb/yr
Meta-Para Cresol Mix 26.4 MM lb/yr

Percent of U.S. Capacity (1987)
Ortho Cresol 40
Meta-Para Cresol Mix 91

Markets Accessible to DGC (1992)

Ortho Cresol 80 MM lbs/yr (including exports)
Meta-Para Cresol Mix 50 MM lbs/yr (including exports)

As the above figures show, DGC's cresol production would be a dominant share of the U.S. market. In the markets accessible to DGC certain foreign markets are included and the possibility of export must be followed up to confirm market potential abroad. Overall, the cresol market is difficult to penetrate. Demand is in decline and users are looking for substitute chemicals because the toxicity of cresols has been called into question by the USEPA and is presently being investigated. Cresol prices are very much subject to wide cycling, and the entry of a large volume of cresols would certainly suppress the price.

However, a number of cresol producers may close plants and abandon the market. Therefore, for specific use a small segment of the domestic market for quality products may open.

# 2.2.5.3 Xylenols

Projected Production m-Ethyl phenol 2,3-Xylenol p-Ethyl phenol	7.6 MM lb/yr
3,4-Xylenols 3,5-Xylenols 2,4-, 2,5-Xylenols	1.7 MM lbs/yr 3.4 MM lbs/yr 6.5 MM lbs/yr
Present U.S. Capacity (1987)	
m-Ethyl phenol 2,3-Xylenol p-Ethyl phenol	20.5
3,4-Xylenols 3,5-Xylenols 2,4-, 2,5-Xylenols	10.5
Markets Accessible to DGC (19	92)
<pre>m-Ethyl phenol 2,3-Xylenol p-Ethyl phenol</pre>	10 MM 1b/yr
3,4-Xylenols 3,5-Xylenols 2,4-, 2,5-Xylenols	50 MM lb/yr

The market for Xylenols, like Cresols, is on the decline. The largest volume demand of Xylenol is the 2.6 Xylenol which is largely produced synthetically and consumed by the producers. Unfortunately, DGC's Xylenol stream has practically no 2.6 Xylenol. On the other hand 2.4 Xylenol are used in the production of antioxidants, 3.5 Xylenols for fungicides, since Xylenols must be tailored to specific applications it will be very difficult to move all the Great Plans volumes of Xylenols within the USA.

# 2.2.5.4 Creosote

Projected Production:	27 MM lbs/yr
Percent of U.S. Capacity (1987)	39
Markets Accessible to DGC (1992)	60 MM lbs/vr

Creosote demand is steadily declining because of its high toxicity, extensive regulatory obligations and shrinking end use. No new technical applications are expected.

#### 2.2.5.5 Arematics

Projected Production
Percent of US Capacity (1987)
Markets Accessible to DGC (199\_)

10 MM gallon/yr 7.1 3,000 MM gallon/yr

The Rectisol naphtha contains a large percentage of aromatics: benzene, toluene, and xylenes (BTX) (See Section 2.3). As such, it is a valuable raw material; however, this stream is relatively low in volume: about 650 barrels per day (10 MM gallon/yr). In view of a strong demand for these aromatics, the market potential for this stream is favorable. Because of the poor economics involved in processing such small quantities, the mixture should be shipped to a refiner and processed there with pyrolysis gasoline to extract the benzene, toluene and xylenes rather than separating the individual compounds at the plant site. However, because of objectionable odor and toxicity the high sulfur content and gumming tendency from the diolefins present, this stream must undergo catalytic hydrotreating and stabilization to make it suitable for shipping.

## 2.2.5.6 CO<sub>2</sub>

Projected Production

180 MMSCFD

Percent of U.S. Capacity (1987) Not applicable

Markets Accessible to DGC (1992) >120 MMSCFD

DGC currently produces 180-200 MMSCFD of low BTU (40-50 Btu/SCF) waste gas that is used as an auxiliary fuel in the boilers. This stream contains about 95-96 percent  $\rm CO_2$ . SI evaluated the market potential of this gas stream for  $\rm CO_2$  flooding in enhanced oil recovery applications.

The survey confirmed the potential demand of  $\mathrm{CO}_2$  in the Williston basin in Western North Dakota and eastern Montana as well as in Canada. However, this demand is contingent on crude prices. Table 2-1 lists the crude price and the respective  $\mathrm{CO}_2$  price that justify the economics of enhanced oil recovery. To justify the economics of enhanced oil recovery, the  $\mathrm{CO}_2$  price should not exceed 20-30 percent of the crude price (dollars per barrel) assuming that 7,000 SCF of  $\mathrm{CO}_2$  is used to produce one incremental barrel of crude oil.

TABLE 2-1

# CO2 PRICE VS. CRUDE OIL PRICE

Year	Carbon Dioxide <sup>l</sup> (dollars per thousand cubic feet)	Crude 011 <sup>2</sup> (dollars per barrel)
1983	1.50	29.35
1984	N/A	28.87
1985	N/A	26.80
1986 (Jan)	0.80-1.50	25.78
1986 (Mar)	0.40-0.60	14.56
1987		17.54

Price for product delivered to Denver City, Texas.

Crude oil first purchase price in Texas.

The assessment also reaffirmed that the  ${\rm CO_2}$  delivery must be via a pipeline. The construction of a pipeline, however, may pose difficulties both financially and with respect to permitting.

#### 2.2.5.7 Argon

prices).

Projected Production	34,500 short tons/year
Percent of US Capacity (1987)	7
Markets Accessible to DGC (1992)	200,000 short tons/year

The demand for Argon has grown appreciably in the last 15-20 years and is expected to level off in the near term. The Argon market is dominated by a few major producers; Air Products, Air Liquide and Union Carbide. With appropriate market strategy DGC has good potential to penetrate and capture a fair share of the North, Southern/North Central market of the United State.

# 2.2.5.8 Krypton, Xenon

Projected Production	2.6 MM liters/year
Percent of US Capacity (1987)	54
Markets Accessible to DGC (1992)	small

There is only limited market for these two rare gases. The projected market for Krypton is in decline while Xenon projections show an upward trend. Thus, market potential for Krypton is less than marginal, while for Xenon it is better than marginal.

Sources: Petroleum Marketing Monthly, Energy Information Administration (crude oil prices); SI estimates (carbon dioxide

# 2.2.6 Recommendations

SI's recommendations can be summarized as follows:

- Current users of the chemical commodities that SI evaluat for DGC are geared to raw materials synthetically manufactured. These users will not relax specifications and will require products of equal quality than those derived from synthetics. Therefore, DGC must develop by-products upgrading processes, which assure high quality products.
- 2. Phenol, Argon and aromatics from naphtha are the products with the largest market potential. Therefore, primary efforts should be concentrated on developing these three commodities. Necessary purification processes should be pursued and a marketing strategy should be developed.

The naphtha stream must be desulfurized and saturated via catalytic hydrogenation in order to make the material amenable to rail or truck transport. Secondly, a refiner for aromatics extraction should be located within reasonable distance to minimize transport costs.

- 3. CO<sub>2</sub> potential for enhanced oil recovery application is contingent on two essential factors: oil prices and pipeline availability. Because higher oil prices are not predicted for the near futures, CO<sub>2</sub> marketing for DGC must be considered only in the long term.
- 4. The marketing potential of Krypton and Xenon is marginal, and development of these two low volume commodities should not be abandoned but should receive low priority.
- 5. Cresols and xylenols required a firm, long term export commitment to justify their full development and marketing.
- 6. Creosote development should not be pursued, at least as a single product direct from tar oil.

APPENDIX H

LCI Report on Task 5: Production Run Recommendation

#### APPROACH TO TASK 5

## A. DEMONSTRATION RUN IN A CONVENTIONAL REFINERY

Experimental work by Amoco Research has shown that the upgrading of Tar Oil to JP-8 Aviation Turbine Fuel is possible under the following conditions:

- o Staged deep hydrotreating
- o 2000 psig reactor pressure
- o Low space velocity (WHSV = 0.25 Overall)
- o Catalyst with high denitrogenation activity

The flow system, recommended by Amoco Research (Figure 1), would be difficult to set up in U.S. refineries because the two existing expanded bed units are too large and a 10,000 Bbl test run would be contaminated by the inventory of the systems. An alternate approach, based on a modified two stage hydrocracker, should be able to provide an acceptable product. This alternate approach consists of five steps:

- o Hot filtration of the Tar Oil to remove the 0.5% solids content. While most hydrocrackers have a feed filter, the amount contained in the Tar Oil is higher than petroleum vacuum gas oil and a prefiltration is advisable to ensure a smooth run.
- Operation of the hydrocracker in a recycle mode through the first stage of the hydrocracker only (which contains a denitrogenation catalyst) to remove the nitrogen, sulfur, and oxygen, and to saturate aromatics. This hydrotreating step is run with a 6/1 product/feed recycle to control heat effects and to ensure that the desired degree of hydrotreating is obtained.
- o Fractionation of the hydrotreated products.
- Hydrocracking of the 550°F+ material using both stages of the hydrocracker with recycle to extinction.
- o Clay treating of the jet fuel product produced.

Referring to Figure 2 and Table I, the filtration, hydrotreating and fractionation steps are as follows:

- o 15,000 Bbl of Tar Oil are hot filtered and sent to storage.
- The hydrocracker is modified to permit hy-passing of the second stage.
- o The first stage of the hydrocracker is operated with a 6/1 recycle/feed ratio.

- The effluent is fractionated and sent to two product tanks:
  - 275/550<sup>0</sup>F Jet Fuel 550<sup>0</sup>F+ Gas Oil
- The fuel gas and naphtha are sent to the refinery for further processing.
- Operation continues with recycle from the above tanks in the amounts indicated in Table I until all of the fresh Tar Oil feed is consumed.
- Operation then proceeds with feed only from the product tanks n until the products in the two tanks reach the following quality goals:
  - 275/550°F Jet Fuel reaches the desired density and aromatics content.
  - 550°F+ gas oil nitrogen and oxygen content is reduced to less than 100 ppm/wt each.

Referring to Figure 3 and Table I, the hydrotreating and clay treating steps are accomplished as follows:

- The hydrocracker is returned to normal operation and charged with the hydrotreated  $550^{\circ}F+$  gas oil. The hydrocracker operates with a 30% recycle.
- The first stage of the hydrocracker reduces the nitrogen content 0 from less than 100 ppm/w to less than 10 ppm/w.
- The second stage of the hydrocracker converts about 70% of the 0 fresh feed to jet fuel and naphtha per pass.
- The jet fuel fraction from the hydrocracker is combined with the jet fuel fraction from the hydrotreating step and clay treated. The feed rate to the clay treater is adjusted to obtain a 1 ft./min. superficial velocity.
- Antioxidant is added (UOP-U3444 at 2.8 PPM) and the product is sent to storage.

Assuming that the required product quality is obtained at a recycle ratio between 6/1 and 9/1 (fresh feed between 10-15% of total feed to reactor) and the desired run length for the demonstration run is about 10 days, we calculate that the hydrocracker capacity should be 6,000 - 10,000 BPSD. Allowing for turndown and allowing the test to range from 5 to 30 days, the acceptable range of hydrocracker capacity would be 3,000 - 30,000 BPSD.

With the above range in mind, Table II was prepared which lists refineries which have hydrocrackers with a capacity of 3,000 - 30,000 BPSD, and the capability of converting at least 50% of feed to lighter distillates. The refineries given in Table II should be able to meet the following conditions but this will have to be established by contract with the refineries:

- 1. Reactor total pressure of at least 2,000 psig.
- Two stage hydrocracker with first stage containing desulfurization/denitrogenation catalyst.
- First stage hydrogen addition potential of at least 500 SCF/Bbl available.
- 4. Ability to fractionate reactor effluent and recycle unconverted gas oil.

If it is decided to prepare 10,000 Bbl of Jet fuel from Tar Oil, then a letter should be drafted to the refineries given in Table II outlining the desired test, the requirements needed for the hydrotreating/hydrocracking step (given above), the material balance given in Table I, and requesting the refiner's interest in preparing the 10,000 Bbl of jet fuel.

#### B. <u>DEMONSTRATION RUN IN OTHER FACILITIES</u>

In addition to the refineries listed in Table II, there are some other leads which should be investigated which could provide the proper processing conditions:

 Syncrude Canada has high pressure hydrotreating facilities for Bitumen which could be used for processing coal tar liquids. Their address is as follows:

> Syncrude Canada Ltd. P. O. Bag 4023 MD 1000 Fort McMurray AB, T9H 3H5 Canada 403-790-6111

2. Southern Services" Advanced Coal Liquefication Facilities have a small pilot plant (20 BPSD) which has high pressure reactors. Their address is as follows:

Wilsonville Advanced Coal Liquefication Facility P. O. Drawer 329 Wilsonville, Alabama 35106 Contact: Bill Hollenack

3. Unocal had operated a Shale Oil upgrading facility in the past in Parachute Creek. No current address is available but Union Oil in Brea, California could be contacted at the following address:

> Unocal Science & Technology Division 376 South Valencia Ave. Brea, California 92621 714-528-7201 Contact: C. P. Reeg V. P. of Chemical Research

Ashland Oil had operated the H-Coal project in Cattlesburg, Kentucky. This 600-1800 BPSD facility is now shut down. The

Charles Hoertz
President Ashland Synthetic Fuels
2000 Ashland Drive

Russel, Kentucky 41169 606-329-3333

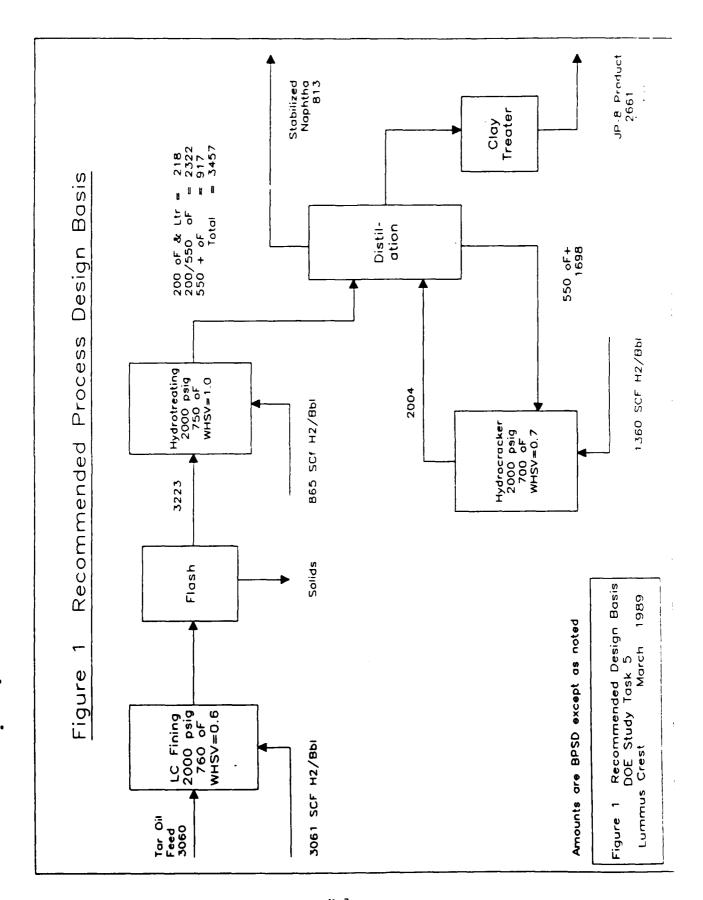
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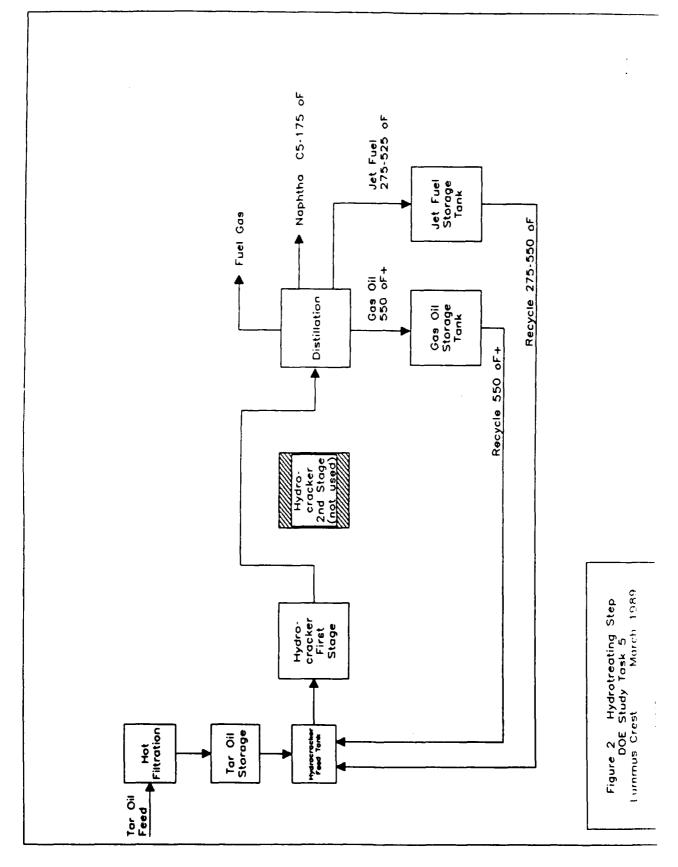
contact is as follows:

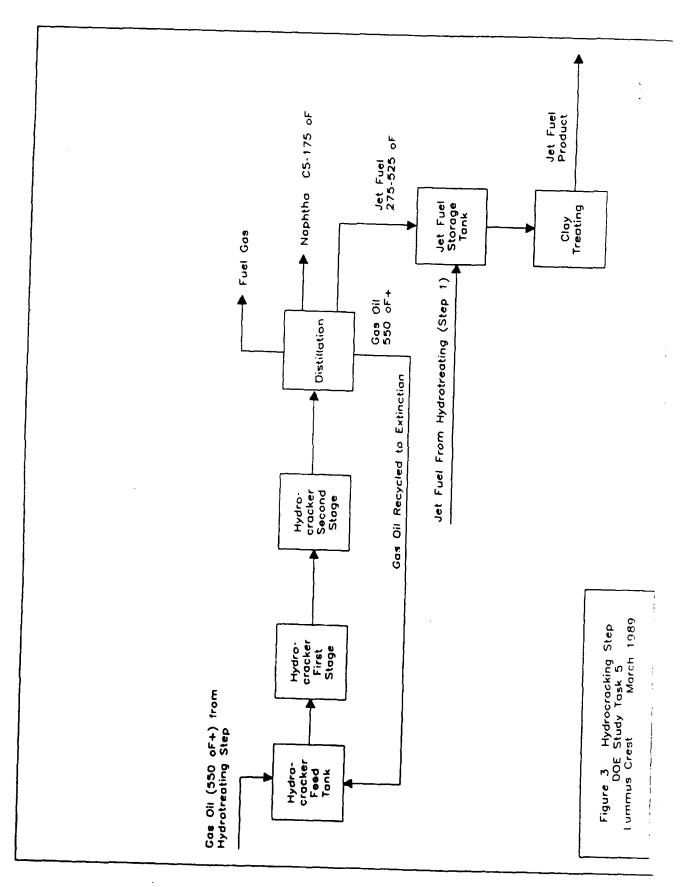
5. Gary Refining has processed Shale Oil in the past and may still have the equipment. Their address is as follows:

Gary Refining Company 115 Inverness Drive Englewood, Colorado 80112 303-797-3800 Contact: Victor Baraldi

6. SASOL in South Africa has hydrotreated Tar Oil in the past to produce distillate fuels.







Component	225	Volx	Grev	2	<b>19</b>	NEX S	WEX M	WEX O	WtX Solid
feed 300/550 of feed 550/1020 of Solids Loss	. 8.08 8.08 8.08 8.08	51.89 47.86 0.23	0.9807 1.0840 2.0000	2670.0 2697.0 27.0		:	:	•	00.00
Total Feed	100.00	100.00	1.0280	5393.9	15000	67.0	0.73	5.44	0.50
Step 2 Migh Pressure Mydrotreating His step uses the first stage of a two stage VGD Mydrocracker. How/NOS Catalyst, and is run initially with a 6/1 recycle ratio. Least 2000 Psig and the temperature is adjusted to 750 of.	first start is run	eating me of a initially	a two stage VGO Hydrocracker. slly with a 6/1 recycle ratio. e is adjusted to 750 of.	VGO Hydr 6/1 recyc ed to 750	ocracker. le ratio. of.	This sta Total pra	This stage must have Total pressure is at	384¢ B	
Component	A1X	Volx	Gr.	OS/#W	8P S0	WER S	VCX N	UtX 0	
feed 300/550 of feed 550/1020 of Recycle 275/525 of Recycle 525/1020	8.03 8.22 41.26	7.41 6.87 44.49 41.23	0.9807 1.0840 0.8400 0.9335	178.0 182.4 915.0 942.4	519 481 3114 2886	0.000 0.000 0.001	0.726 0.726 0.000 0.001	5.443 5.443 0.000 0.020	
Total Oil Feed Chemical M2(100%)	6.0 9.0	100.00	0.9057	2217.8	7000	0.080	0.118	0.893	
Total Feed	100.90	100.00	0.9057	2237.8	7000	0.0	0.12	0.89	-
Total Reactor Products N.28 NN13 NN13 C1/C4 C5/275 of C27/255 of S27/1020 of	cts 0.08 0.14 1.00 1.00 2.50 48.33 47.84	3.14 52.11	0.7200	1.9 3.2 22.3 22.2 22.2 55.4 1071.9	220 3648 3249	0,000	0.000	0.000	
Reactor Products	100.90	101.67		2237.8	7117	0,000	0.000	0.002	
Met Products M28 M170 C1/C4 C27/C5 of 275/525 of 525/1020 of	0.52 0.88 6.18 6.15 15.38 72.52 32.89	22.01 53.39 36.31	0.7200	22.2 22.2 22.2 25.2 4.56 118.6 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8	220 534 363 363	0.000	0.00	0.000	
461 71 000019	1			755.1	:		;	•	

Table | Continued

Step 3 Migh Pressure Nydrocracking
managementanessesses and stage VGO Mydrocracker.
This step uses both stages of a two stage VGO Mydrocracker.
The Mydrocracker rowsers 20 M of 4440 mer one Tree of a

Component	KX	Volx	Grev	OS/#H	05.48	NCK S	<b>KK #</b>	41X 0
Feed 550/1020 of Recycle 525/1020	88 88	66.00 32.00	0.9335	118.6 50.8	363	0.001	0.00	0.020
Total Dil Feed Chemical H2(100%)	100.00 1.88	100.00	0.9068	169.4	534	0.001	0.001	0.014
Total Feed	101.88	:	:	172.5	:	:	:	:
Total Reactor Products	ducts			•				
#22 ##3	8.8			0.0				
2	0.01			0.0				
C1/C4	2,8			11.9				
C5/275 of	17.50	20.11	0.7200	8.62	118	0.000	0.000	0.00
275/525 of	47.37	49.07	0.8250	80.2	278	0.00	0.000	0.00
525/1020 of	30.00	30.16	0.8200	50.8	171	0.000	0.000	0.00
Bearing Broducts		8	0 8107			: 8 : 6		

0.000 0.000 0.000

0.000 0.000 0.000

TABLE II

LIST OF REFINERIES WITH HYDROCRACKING CAPACITY

Refinery Name & Address	Contact & Phone	Capacity BPSD	<u>Feed</u>
Tesoro Petroleum Kenai Refinery Box 3691 Kenai, AK 99611	Jose Verdin 907-776-8191	9,000	Residue
Atlantic Richfield Watson Refinery Box 6210 Carson, CA 91749	A. W. Johnson 213-548-8000	22,000	Dist.
Chevron U.S.A. Richmond Refinery Box 1272 Richmond, CA 94802	J. P. Krider 415-620-3000	30,000	Residue
Mobil Oil Torrance Refinery 3700 West 190th St. Torrance, CA 90509-2929	L. K. Williams 213-328-2550	21,700	Dist.
Mobil Oil Beaumont Refinery Box 3311 Beaumont, TX 77704	J. A. Jones 409-883-9411	32,000	Dist.
Texaco Port Arthur Refinery Box 712 Port Arthur, TX 77640	R. E. Anderson 713-982-5711	15,000	Dist.
Texaco Bakersfield Refinery Box 1476 Bakersfield, CA 93302	D. R. Hall 805-326-4200	14,300	Dist.
Texaco Los Angeles Refinery Box 817 Wilmington, CA 90748	R. E. Morris 213-835-8261	20,000	Dist.
Tosco Avon Refinery Martinez, CA 94553	J. M. Cleary 415-228-1220	23,000	Dist.

Refinery Name & Address	Contact <u>&amp; Phone</u>	Capacity BPSD	<u>Feed</u>
Unocal 1660 West Anaheim St. Box 758 Wilmington, CA 90744	A. V. Mandlekar 213-513-7600	22,000	Residue
Texaco Delaware City Refinery Delaware City, DE 19706	R. C. Mifflin 302-834-6000	19,000	
Hawaiian Independent 733 Bishop St. Suite 3000, Box 3379 Honolulu, HI 96813	Everett Lewis 808-547-3222	16,000	Residue
Clark Oil, Blue Island Division of APEX Oil 8182 Maryland Ave. St. Louis, MO 63105	S. A. Goldstein 314-889-9600	9,500	Dist.
Marathon Robinson Refinery Robinson, IL 62454	K. N. Warren 618-544-2121	23,000	Dist.
Kerr-McGee Wynnewood Refinery Box 305 Wynnewood, OK 73098	John L. Ray 405-665-4311	5,000	Dist.
Total Arkansas City Refinery 1400 South M St. Arkansas City, KS 76005	Jack Hazen 316-442-5100	3,200	Dist.
Exxon Baton Rouge Refinery Box 551 Baton Rouge, LA 70821-0551	D. H. Daigle 504-359-7711	24,000	Dist.
Exxon Billings Refinery Box 1163 Billings, MT 59103-1163	J. A. MacFarlane 406-657-5380	4,900	Dist.
Exxon Benica Refinery 3400 East 2nd St. Benica, CA 94510-1097	D. L. Wiggins 707-745-7011	29,500	Dist.

Refinery Name & Address	Contact & Phone	Capacity BPSD	<u>Feed</u>
Sohio 1150 South Metcalf St. Lima, OH 45804	P. Oves 419-226-2300	23,000	Dist.
Sohio Toledo Refinery Box 696 Toledo, OH 43964	J. T. Jacobson 419-698-6408	35,000	Dist.
Sohio Marcus Hook Refinery Box 428 Marcus Hook, PA 19061	J. M. Gibson 215-499-7000	21,000	